Challenges for the future in an ICT context

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For Stig

Stig, this anthology is our gift to you in celebration of your more than 30 years work not only at Mid Sweden University, but also on the international research scene. You have so often shared your thoughts and visions with us, now it is our turn to give you something in return. As editor and on behalf of all the contributors to this book, I would like to express our warmest thanks to you.
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INTRODUCTION

In 1977 the first informatics education program (Systemvetenskapliga programmet) started at Östersund University College, a predecessor to Mid Sweden University. At that time decisions about which universities were permitted to accomplish which education was made at the national level. As Östersund University College not themselves had asked for this program it was a bit of a chock as there very hardly any competence in the field present. After a fumbling start it was obvious that there were a need to appoint someone with competence. That was how Stig entered the scene. From the moment he started his work and till the day he retired he took command over the education and made it a well thought-out education with high academic standard. Many former students have acquired high positions and many are those who express their gratitude to Stig.

Not only have Stig devoted himself to education, but also to research. He has also inspired us, his colleagues, to take interest in research. He has also willingly opened his networks for us and encouraged us to go contribute to relevant conferences. We owe Stig a lot for his engagement.

Stig have a wide network of research colleagues around the world where some of them also have become very good friends. In this book some of his research colleagues and good friends have contributed. In the last part of the book, contributions from colleagues at Mid Sweden University are presented. The articles in the book cover a wide range of areas with the common theme to approach challenges for the future.
Fear for Sustainability? A Simulation Study
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ABSTRACT
The question addressed in this contribution is whether fear / anxiety is an emotion that inhibits or fosters the sustainability of our planet. To be meaningful, this question has to be modified straightaway: Can fear be a factor for the enhancement of sustainability? If so, how? Fear, if it is pathological, can paralyze. But in its healthy forms it can stimulate coping behavior. The threats to the sustainability of our planet are manifest in the crisis of the last years. This is a systemic crisis, and that is what makes it intractable. The system that is now in crisis is constituted in a way that crises must occur, again and again. A closer look shows that the economic, social and ecological spheres are not at all distinct, but intertwined, which makes most policies obsolete, and even worse, leads to ever increasing damage to the natural environment. Fear / anxiety per se is not the best advisor, but the adaptive function of fear can trigger new collective behaviours toward sustainability, as will be demonstrated with the help of a System Dynamics model.

Keywords: Sustainability, Natural Environment, Fear, Anxiety, Adaptiveness

1. INTRODUCTION
The title of this contribution is ambiguous. On the one hand it expresses an anxious concern, a fear that the natural environment is endangered. The other meaning imputes that fear can be a force for sustainability. Can fear / anxiety be a driver towards a sustainable world? The purpose of this paper is to try to answer this question so that light can be shed on the role of fear or anxiety in the quest of humanity for ecological sustainability.

In the first place, a definition is necessary. The terms "fear" and "anxiety" will be used interchangeably, even though subtle semantic differences exist. For example, fear refers to a specific threat, while the sources of anxiety are indefinite (Russell Davis 1985; May 1977) and relate to a longer-term problem. While fear refers to the experience of apprehension (Rachman 1985) - an unpleasant and often strong emotion stemming from an expectation or awareness of danger - anxiety
has the connotation of inquietude, a painful or fearful uneasiness of mind (Webster 44, 366). For the purpose of this presentation, one can by and large abstract from these differences. We will use both terms, suggesting that threats to sustainability can evoke both - fear in the short term and anxiety in the long term.

The unit of analysis is a collective, not an individual. Fear / anxiety, then, will be referred to a society as a whole. In other words, the context considered is the social domain.

This is a theoretical paper. Empirical work is drawn only from secondary sources. Following the tradition of critical rationalism, the propositions are formulated in a way that permits their falsification (Popper 2002). A simulation model which embodies the proposed theory will be used as an approach to “modeling as theory-building” (Schwaninger and Groesser 2008): ensuing challenges of the model and improvement of its functions can potentially improve the theory.

After these preliminaries, the chapter will proceed with a perspective on the dynamics of fear. Thereupon, a dynamic simulation model will be constructed and validated. The results of ensuing simulations will then be discussed. Finally, implications and conclusions will be derived.

2. THE DYNAMICS OF FEAR - EXAMPLES

The concept of fear tends to be used in a static manner. However, in the real world fear has eminently dynamic features: it can grow and decrease, the process of increase being self-reinforcing in nature. Two examples will be given, the first of which shows the impact of media activity on the fear in a population (Figure 1).

![Diagram of fear and media dynamics]

Figure 1. Dynamics of fear and the media
A fatality, such as a crime or accident, happens. Serious incidents are reported because they are dramatic, tragic and frightening (Gardner 2009). Immediately, the media produce information, distributing it to the public. If the information thrives on the fatalities and dangers of the case in point, fear is produced. The more people fear, the more information they want. The response of the media is to deliver more information, in more detailed and more fear-inspiring ways. As this circular process continues, a process of proliferation is put in operation: here, of course, we have a mammoth feedback loop.

![Figure 2. Dynamics of a culture of fear](image)

The second example is typical for organizations in our day (Figure 2). A crisis hits the economy, leading to a dip in the revenue of a company. The company reacts with a layoff, "downsizing" the workforce. People leave, and with them go their brains. Those remaining get overloaded. Stress is the consequence. With some delay (denoted by the cross beam [] on the arrow), burnouts will happen, and more brains will leave the company. We call this circle the demolition loop: sooner or later the company is demolished (always with the footnote ceteris paribus, - all other things being equal). The second loop, which is linked to the first one, starts with the fear evoked by downsizing, which again produces stress. Workers under stress tend to impair the quality of their products. Less quality entails less revenue. This is the success/failure loop. Like the demolition loop, it is self-reinforcing (in both cases, the product of the signs on the arrows that make up the loop is "+"). The third loop is the combination of the first two. We call it the erosion cycle. The last
cycle is the *fatality* cycle: fewer brains lead to less innovation, and less innovation, after some time, implies less revenue. The whole network expresses the calamitous interrelationships in a culture of fear which can lead to the demise of a firm. But the diagram also puts into evidence the fact that there are ways of counteracting this pathological trajectory. One could not downsize at all. Or one could foster innovation in new ways, eliminating the fatal link between the number of brains and the intensity of innovation.

Up to this point, we have studied two examples of the dynamics of fear in a qualitative manner. The method used was the causal loop diagram, which is part of the system dynamics methodology.\(^1\) In the following, a more encompassing model will be developed. It will first be conceptualized in qualitative terms and then implemented quantitatively.

### 3. SYSTEM DYNAMICS MODEL

The purpose of the system dynamics model is to examine the interrelationships between fear/anxiety and the state of the environment. It should enable one to explore the interaction of fear and sustainability. Any model should be designed with a view toward its potential users. In the case of the model to be presented here, the perspective is a holistic one - that of a politician or researcher looking at the connections among the big aggregates which characterize the system under study, and the synergetic dynamics which they generate. The model is theory-driven, and the modelling approach primarily a deductive one.

#### 3.1. Qualitative Model

First, we draw the qualitative model. The diagram shown in Figure 3 shows the model's basic logic.

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\(^1\) System Dynamics (SD) is a methodology for the modelling and simulation of complex systems, developed by Prof. Jay Forrester at MIT (Massachusetts Institute of Technology), and grounded in Control Theory as well as in the modern Theory of Nonlinear Dynamics (see: Forrester 1961; Sterman 2000). The focus of SD is on issues which are modelled as systems made up essentially of stock and flow variables forming closed feedback loops and simulated as continuous processes. The mathematics of the models is based on differential equations.
It is of the causal-loop-diagram type, used in System Dynamics (Lane 2008).²

![Diagram of Fear and sustainability - qualitative feedback system](image)

**Figure 3. Fear and sustainability - qualitative feedback system**

Fear can trigger either the liberation of energies for overcoming the causes of the fear, or it can lead to indifference if not paralysis. In the first case, it is a constructive force by which the source of concern can be neutralized. The countervailing tendency - in the latter two cases - are those of neglect and ultimately of obstruction.

The adaptive value of fear, as emphasized by Richard Lazarus and others, is that an arousal of fear stimulates the search for a means of coping with difficulties or dangers (Bachmann 1978). We know that existential fear has been a major factor in the generation of human culture (Hankiss 2001). On the other hand, it is also known that excessive fear can jeopardize psychological functioning, leading to depression, errors of perception, paralysis and destruction (Bachmann 1978, Krohne 2010). The only way to learning, development and maturity is in confronting anxieties, while trying to evade them leads to obstruction, stagnation and immaturity (Tillich 1952; May 1977).

The main loop in the diagram is what we call a **Sustainability Loop** - a balancing loop³ denoted as *B1*. It shows the adaptive function of fear, which triggers effective

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² In the modelling process, more detailed causal-loop diagrams were elaborated, from which the essential variables were extracted successively. We refrain from printing all of these diagrams, limiting ourselves to the one which is the most insightful from a didactic point of view.
action, in turn entailing the restoration of the natural environment. The state of the environment impinges on environmental consciousness in a dampening way: the better the state of the environment, the lower the environmental consciousness, and vice versa. Environmental consciousness dampens indifference vis à vis the environment. Indifference then dampens fear (Indifference Loop B5), while high fear can also increase indifference, directly or via paralysis (Paralysis Loop B4). The higher the indifference, the higher is the exploitation of the environment, because an indifferent population cares next to nothing about protecting or restoring the environment. Exploitation deteriorates the state of the environment. Via environmental consciousness, the loop is closed (Conscience Loop B3). Assuming that, besides the indirect influence of the state of the environment on fear via environmental consciousness (B1), there is also a direct influence in the same direction, we get a Small Restoration Loop (B2). There is one self-reinforcing loop, connecting indifference, exploitation, state of the environment and fear (R1). In this case, fear leads to more fear, and the state of the environment develops in one and the same direction - either it increases or decreases exponentially (ceteris paribus, i.e., all other aspects being equal). We have drawn more detailed qualitative diagrams, which we shall not present here so as to avoid unnecessary detail. The additional aspects that were included will be captured in the quantitative model.

In sum, we have five balancing loops and one self-reinforcing loop. It is difficult, however, to say what the compound dynamic behavior of the system under study is. We can certainly assume that it will be non-linear. But to gain additional insights about the system under study, we need to revert to a quantitative model.

3.2. Dynamic Hypothesis and Reference Mode

We started off with some deliberations about the likely behavior of the system under study. The dynamic hypothesis is embodied in the closed-loop diagram just explained. We assume a reference mode, i.e., a system behavior that is likely to occur if nothing is changed actively in the system (Figure 4).

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3 A balancing loop is the case in which the product of the signs of all the arrows which constitute it is negative. In the case of the Sustainability Loop, we have three "+" and three "−", their product being "−". Therefore it is a balancing loop (labeled with B). In the case of the Exploitation Loop, we have two "+" and two "−", the product being a "+". Therefore it is a self-reinforcing loop (labeled with R). Rule: Loops with an uneven number of negative signs are balancing loops, while all other loops are of the self-reinforcing type. The methodology of System Dynamics is available in Forrester (1961) and Sterman (2000), among others.
The basic pattern assumed is an oscillation of all three variables, state of the environment, collective anxiety, and effective action. The oscillations of the latter two have the inverse shape of the oscillation of the former. One can also discern time lags between the three variables, given that the reaction of anxiety to both changes in state of the environment and the triggering of effective action is being delayed.

3.3. Quantitative Model

In the following, the quantitative system dynamics model will be described, which is construed on the basis of the qualitative structure presented in the last section. The stock-and-flow-diagram of the model is shown in the Appendix. 4

The model is formulated in the form of differential equations underlying the variables and connections represented in this stock-and-flow diagram. The time horizon chosen is 100 years (400 quarters).

It is evident that the quantitative model exhibits additional details in comparison with the qualitative model shown in Figure 3. The main additional features are:

- Differentiation between stocks and flows: The model has five stocks, (1) anxious people, (2) indifferent people, (3) education level, (4) knowledge, and (5) state of the environment.
- The constructs fear and indifference from the CLD are now operationalized in stocks (1) and (2). The aspect of paralysis is implemented in the link

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4 The model is made up of stocks (symbolized by the boxes), flows (valves), auxiliary variables (endogenous variables) and parameters (exogenous constants or variables triggering scenarios). The links represented by arrows denote causal connections. See also Lane (2008).
between intensity of fear and commitment, where high levels of fear lead to a
collapse of the influence on commitment.

- New are stocks (3) and (4); the levels of education and knowledge impinge on
both ecological consciousness and the effectiveness of action for
environmental restoration.

- The state of the environment is on the one hand improved by restorative
action, and on the other hand undermined by deteriorating impacts
stemming from indifference which triggers detrimental behavior, such as
patterns of reckless consumption.

- The state of the environment is considered in two ways, the actual state (stock
(5)) and the desired state of the environment. The difference between the
two, measured as a discrepancy, triggers flows between stocks (1) and (2), in
conjunction with the state of environmental consciousness. In addition, the
discrepancy between actual and desired states of the environment causes
changes in the intensity of fear; with an S-shaped relationship of the impact
of discrepancy on fear.

- Fear impinges on the commitment of people to improve the environment,
with an S-curve until a maximum, and then - as briefly mentioned above -
a collapse in the region of paralysis (due to high fear).

For the purpose of testing, policy and scenario levers have been included:
currently, the model contains a number of policy levers, which can be set at
different values, to test policies, e.g., for investment in restoration, investment in
education, incentives for environment-friendly behavior, and money for defensive measures
to mitigate environmental deterioration. An example for a scenario input is the
parameter commitment scenario, by which different levels of commitment can be
tested for their impact. More of these levers can be inserted, if needed.

At this point we will proceed with an analysis of the system behavior shown
in the simulations, and try to derive insights from them.

4. SIMULATIONS

First we will give an overview of the behavior of the simulation results
(Figures 5 to 7).
As the state of the environment deteriorates, collective anxiety grows with some delay, and it only cools down once a substantial improvement of the state of the environment has been achieved (Figure 5). Between the minimal value of state of the environment and the maximum of collective anxiety, there is a delay of roughly 40 years, a magnitude that exceeds our estimate in the reference mode by far.

Figure 5. State of the environment and collective anxiety

Figure 6. Ecological consciousness and state of the Environment
The interplay of environmental consciousness and the state of the environment is visible in Figure 6. Environmental consciousness awakens only as the environment deteriorates. It keeps growing during further degradation and beyond, until the state of the environment is back at a high level. The fact that it falls into decay about 12 years before state of the environment has reached its maximum, can be explained by the effect of complacency among the affluent.

![Overview III](image)

**Figure 7.** Collective anxiety and effective action

*Collective anxiety*, which is influenced by the state of the environment, is a trigger for effective action, which again is facilitated by knowledge. The time lag between the anxiety and the action amounts to 10 years (Figure 7).

Altogether, the patterns produced by these simulations show some similarity with those estimated as reference modes (Section 3.2). We will refrain from comparing the two sets of time series - those in the reference mode and those in the simulation outputs - to avoid pseudo-exactitude and even spurious precision. The next Figures - 8 to 10 - show the evolution of the state of the environment as a function of different levels of fear. For these simulations, *intensity of fear* was exogenized, i.e., set as a parameter. In the case of Figure 8, simulation runs for three levels of *intensity of fear* were compared - low, high, and intermediate.
Figure 8. State of the environment (SoE) as a function of fear. The lowest "performance", in terms of environmental state, results from high fear, while intermediate fear breeds the best results. Apparently, that represents a "healthy" level of fear, which mobilizes more energy for restoring the environment. These results are not totally unexpected, but the size of the gain is surprising.

Figures 9 and 10 show additional scenarios; these are run across a time frame of forty years (160 quarters), so that a concentration on the first development cycle can be maintained. Figure 9 compares the high and intermediate ("healthy") fear scenarios with an additional one - the scenario that applies to societies in which fear is a taboo. In other words, fear is forbidden, and confidence is the obligation. The great psychiatrist Horst-Eberhard Richter calls this state the "okay morale", and diagnoses a collective neurosis (Richter 2005:44) which suppresses alarm signals that call for protection or restoration of the environment. This is reflected in the behavior shown in the okay society scenario: if fear is set at zero or even negative values, the state of the environment continues deteriorating, because the commitment to change anything, while not quite at zero, stays at a very low level.

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\(^5\) The vertical axis shows the value of State of the Environment, smoothed over the duration of the simulation. The fear parameter (exogenized intensity of fear) is set at three different levels.
Figure 9. State of the environment (SoE) as a function of fear II

Figure 10 is a resumé of the scenarios just analysed, with an important addendum: The reframing parameter is activated. This is a lever by which the effectiveness of actions can be increased due to a new, mostly unorthodox approach. Such an approach needs creativity (implemented in the reframing lever) but also new knowledge (coming from the stock variable knowledge, which is in a multiplicative relation with reframing).

Figure 10. State of the Environment (SoE) - Scenarios

Finally, we explore two policy scenarios and compare them with the base scenario (Figure 11).
Figure 11. Policies for improving the state of the environment (SoE)

The first is a policy of environmental protection, implemented through the lever money defensive measures. This policy improves the situation beyond the base scenario. The second policy consists in a substantial investment in education. The diagram shows that the latter policy is by far superior to the former one. The reason must be sought in the defensive nature of the environmental protection policy. We could very well go on, now, running additional scenarios, but we must abide by the space restrictions of this contribution.

5. MODEL QUALITY

It is important to gauge the quality of any model one builds, because only good models will enhance progress. For this purpose we revert to a list based on Howe (2007) and Schwaninger and Groesser (2008):

1. Refutability: the ability of a theory to be falsified (refuted) or supported. In principle, all model outputs can be falsified on the basis of empirical data or logical arguments.
2. Importance: the quality or aspect of having great worth or significance. According to a study conducted in Switzerland, fear of ecological threats has been number one among the most important menaces perceived by the population since the

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6 The precise formulation of that principle is the Conant-Ashby theorem (Conant and Ashby 1981).
1990s (Raymann 2005). Therefore, from an empirical standpoint, examination of the connection between fear and the environment is necessary.

3. Precision and clarity: a state of being clear, allowing hypotheses more easily to be developed from the theory. Overall, the quantitative model is undergirded by formulas that express the relationships between the variables in a precise and clear way.

4. Parsimony and simplicity: uncomplicated; limitation of complexity and assumptions to essentials. The model is limited to the essential variables representing the system under study. Variables and parameters amount to no more than 46.

5. Comprehensiveness: covering completely or broadly the substantive areas of interest. The adopted view is a broad one, including the ecological, economic and socio-cultural dimensions.

6. Operationality: specific enough to be testable and measurable. The high level of aggregation and abstractness makes it somewhat difficult to test the model empirically. Variables such as state of the environment, fear, knowledge, etc. are difficult to measure, but not beyond estimation.

7. Validity: valid, accurate representation of the real system under study. As the model is conceptual-theoretical in nature, the most important validation tests are those of structural validity. The following tests were carried out:

   - Direct structure tests: The main theoretical foundations for the parameters and relationships, as well as certain empirical underpinnings, were given in the description of the model (sections 3.1. and 3.3.). On that basis, structure and parameter examination tests, extensive walkthroughs and semantic analyses were carried out. Further tests included boundary adequacy tests and dimensional consistency tests.

   - Indirect structure tests: A number of routine tests, e.g., extreme condition tests, behavior sensitivity tests and phase relationship tests were completed.

   - Behavior tests: The standard battery of modified behavior tests, behavior anticipation tests and behavior anomaly tests was applied. What could not be implemented was the behavior reproduction test, i.e., the comparison of simulation results with real-world data, because the model is a theoretical one.

Some of the tests helped improve the model considerably. For example, an extreme behavior test brought to the fore a flaw in one equation that led to negative values for the state of the environment, an error that could be easily mended.

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The tests enumerated here are described in detail in Forrester & Senge (1980), Barlas (1996), Schwaninger & Groesser (2009).
8. Fruitfulness: statements are made that are insightful, leading to the development of new knowledge. The connection between fear and sustainability is herewith examined for the first time. The development of the model as such is a gain. New relationships have been discovered. The insights derived from the model, while they are not groundbreaking, do substantiate assumptions that to date were exclusively intuition-based.

10. Practicality: provides a conceptual framework for practice. The model provides a new framework that enables a purposeful exploration of the connection between fear and ecological sustainability.

6. CONCLUSION

In line with the purpose of this contribution, we have tried to shed light on the role of anxiety in humanity’s quest for ecological sustainability. The research question was whether or not fear / anxiety can be a driver for a sustainable world. The answer coming from our exploration is that fear, in principle, has a strong potential for influencing the drift of ecology through human agency, or, in better terms, through social agency. This answer can be qualified on analytical grounds.

Our analysis of the simulations has led to a number of insights:

1. Oscillation: The system under study oscillates, showing patterns of overshoot and collapse. This makes sense; the story of the rise and fall of systems is well reflected in the model. What could be further discussed is the current cycle length of 80 to 90 years. This may well be too short, and should be reviewed at a later stage, in the light of empirical accounts that might become available.

2. Nonlinearity: The nonlinearity of the system generates responses that were not expected, at least to a certain extent. Higher levels of anxiety do not necessarily lead to a better state of the environment. There is an intermediate (“healthy”) level of fear that entails the best results in terms of ecological restoration.

3. Delays: In the system at hand, the delays are longer than we would suppose. The magnitude of the delays goes far beyond our estimates made in the reference modes.

4. Levers of change: The level of ecological restoration can be influenced. The investment of more money, however, is not always an effective policy. In contrast, an extraordinarily powerful lever of change comes with investments in education and the corresponding creativity that leads to a reframing of the approaches to restoration.
The model confirms the supposition that fear, if it becomes pathological, can paralyze. However, in its healthy forms, it can stimulate coping behavior and adaptiveness. An absence of fear can foster dangerously careless behavior (Bachmann 1978). Or, to put it in the categories pronounced by Horst-Eberhard Richter (2005): a society in which confidence is mandatory and anxiety a taboo deprives itself of a vital alarm signal, which could warn everybody about imminent and irreversible damages to the conditions of life. This is probably the most important lesson emanating from our exploration.

A number of significant aspects could not be covered in this short contribution, and so should be examined in a follow-up. One should determine if some of the qualitative variables in the model are amenable to measurement, and if so, how. Also, the length of the delays needs to be reviewed. Finally, control strategies for the system under study should be elaborated: Can overshoot and collapse be avoided? And also, how can the system be brought into balance?

These are some of the tasks ahead, and they should be fulfilled within the ambit of improving the real system under study. We are here to change the world, not all at once, but step by step.

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REFERENCES


Stock-and-flow diagram of the quantitative model
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ABSTRACT

The ability to predict decision making and overt behaviour of an individual is broadly accepted as being possible through personality trait theory. The traits are pendants that through control processes orientate an individual towards certain futures. The same notion can be applied to organisations, though until now only metaphor has been available to explain this. Now, however, cybernetic theory has been developed that enables organisational personality to be explained in depth, and offers the potential to predict empirically an organisation’s behaviour, and relates to not only an organisation’s conduct, but also its misconduct. The conceptualisations develop from the use of agency theory that explains the socio-cognitive aspects of self-organisation and the efficacy of connections between the traits that control the organisation’s personality. The theory models the cognitive processes that are responsible for trait states. These operate through intelligences, and a number of forms are considered, including cultural, social and emotional. The development of the theory draws on work from psychology that it uses in a social psychology context - where organisations are seen to be social collectives that operate with their own social psychological processes, through the formation of collective norms. One of the consequences of the theory is to explain what happens when organisations in some way fail in their internal processes, this occurring through identifiable pathologies that can result misconduct.

Keywords: Organisational Modelling, Knowledge Cybernetics, Pathology, Complexity, Personality, Pathology.

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Maurice Yolles is an emeritus professor in Management Systems at Liverpool John Moores University. His doctorate, completed about three decades ago, was in mathematical social theory, in particular the formal dynamics of peace and conflict. Since then he has published two research books in the field of management systems/cybernetics (with a third in process), and well over 200 academic papers some of which he has received awards for. He was research director for the International Society for Systems Science for a number of years, and he now heads the Centre for the Creation of Coherent Change and Knowledge which runs courses and does research into transformational change. Within this context he has also been involved in a number of international research and development projects for the EU and in Asia. He is the editor of Journal of Organisational Transformation and Social Change.
Prof. Gerhard FINK
Gerhard Fink is retired Jean Monnet Professor. During 2002-2009 he was Director of the doctoral programs at WU (Vienna University of Economics and Business), Austria. He was the Director of the Research Institute for European Affairs during 1997–2003. He can refer to about 220 publications in learned journals and authored or (co-) edited about 15 books, in 2005 he was a Guest Editor of the Academy of Management Executive. Since 2007, he is Associate Editor of the European Journal of International Management. His research interests are in: organisational change and business strategies in the European market(s), international business, intercultural management. In 2009 he received an award (with Yolles) from Emerald for a highly commended paper on personality theory.

Introduction
Seeing organisations as social collectives with a culture and collective cognitive processes brings organisation theory directly into the sphere of social science. Here collective cognition exists, and so too does the notion of a collective mind that operates on normative principles (Yolles, 2008). This in turn leads to an elaboration of the field of social psychology: the study of the relationship between human mind(s) and social behaviours. In concert with the Mead Project (2004), social psychology can refer to the psychology of a structured collection of individuals among which has arisen a normative mind, and operates in a way that may be distinct from that of the individuals that make it up.

So, in this paper a cybernetic psychosocial view will be adopted to theoretically explore durable organisations as a behavioural agency with a collective mind. Psychosocial approaches to the modelling of organisational processes are not new. In concert with this, Weick (1969 & 1995) adopted the idea of corporate personality metaphorically (Brown, 2004), i.e. to make organisations compact, intelligible and understood (Cornelisson et al. 2008). This metaphor is well known (e.g. Olins 1978; Davenport et al. 1997; Gindis 2009; Barley 2007), but seems to be more popular in the niche area of Identity Theory (as part of Strategic Management and Marketing: e.g. Taylor 2000; He and Balmer 2007) and in Human Resource Management where, for instance, Natoli (2001) proposes that corporate personality operates through traits.

In an attempt to understand organisational pathologies, Kets de Vries’ (1991) has explored the corporate personality in terms of its pathology and dysfunction, and reflecting on psychological tendencies such as corporate neurosis, guilt, collective psychological defences that reduce pain through denial and cover-up, and unproductive power processes. It is likely that the dysfunction arises when pathologies fall into contextual patterns. Sperry (1995) has identified a number of classes of corporate dysfunction that include strategy/structure mismatch,
structural problems, environmental problems, human resource problems, strategy/structure/culture problems, and a host of other problems that might be better expressed as problems that occur under the umbrella of corporate personality disorder like corporate neurosis.

Our intention is to create a psychosocial framework for the collective mind of an agency that we call its normative personality. The term normative personality is not new, being usually used within the context of the ambient normative social influences that exist during the formation of personalities, and that mould them (Mroczek & Little, 2006). Our interest lies in recognising that the norms in a collective may together coalesce into a unitary cognitive structure such that a collective mind can be inferred, and from which an emergent normative personality arises. To explain this further, consider that stable collectives develop a common dominant culture within which shared beliefs develop in relation to the capacity of the collective power to produce desired outcomes. Cultural anchors are created that are represented within the paradigm that the agency carries, which enables the development of formal and informal norms for patterns of behaviour, modes of conduct and expression, forms of thought, attitudes and values that are more or less adhered to by its membership. When the norms refer to formal behaviours, then where the members of the collective contravene them, they are deemed to be engaging in illegitimate behaviour which, if discovered, may result in formal retribution - the severity of which is determined from the collective’s ideological and ethical positioning. This develops with the rise of collective cognitive processes that start with information inputs and through decision processes result in orientation to action. It does this with a sense of the collective mind and self. It is a short step to recognise that the collective mind is associated with normative personality. Where a normative personality is deemed to exist, it does not necessarily mean that individual members of the collective will conform to all aspects of the normative processes: they may only do so “more or less”. In the remainder of this paper, when we refer to normative personality, we shall mean the development of the collective mind and its emergent normative personality.

There are few cybernetic approaches that relate to normative personality. One of these comes from Bandura (2006) in his agency theory of the personality. Here, an agent is seen as having the cognitive capacities of intention, forethought and the ability to react and to reflect, and it is from these capacities that the agentic perspective arises through which adaptation and change in human development occurs. To be an agent is to influence intentionally one’s functioning and life circumstances, and personal influence is part of the causal structure. Agential systems are seen to be self-organizing, proactive, self-regulating, and self-reflecting, and they are participative in creating their own behaviour and contributors to their life circumstances. In his theory of agency, Bandura (1994 & 1999) links information processes with both the self-efficacy of an individual agent
and the “collective efficacy” of a collective agent. The efficacy of agencies relates to “the soundness of their thoughts and actions, and the meaning of their pursuits, and they make corrective adjustments if necessary” (Bandura 2006: 165). Efficacy is conditioned by emotive imperatives (deriving from emotions and feelings) that can be controlled (Adeyemo, 2007) by emotional intelligence (Salovey & Mayer, 1990). Efficacy therefore influences an agent’s capabilities to produce designated levels of performance that exercise influence over events that affect life. Bandura (2006) also refers to empirical research that shows that perceived collective efficacy accounts for distinctions in the quality of group functioning in diverse social systems. In referring to perceived collective efficacy, he means the common beliefs that reside in the minds of group members about their collective capability. The membership believes that they are acting on their common beliefs that contribute to the transactional dynamics that promote group attainments. In this paper we will align efficacy with perceived efficacy since the latter constitutes the principle way of measuring the former.

In a distinct approach, Van Egeren (2009) has been interested in agents and their and traits. Agency theory refers to Bandura’s (1999) socio-cognitive theory, and trait theory is based on and reflective of emotional-motivational systems that are able to increase adaptation to classes of stimuli associated with positive and negative reinforcement (Depue & Morrone-Strupinsky, 2005, p. 314, cited in Van Egeren, 2009). For Davis (2002) durable personality traits are usually tightly bound to qualities of emotions, but they may also be defined in terms of preconscious mental dispositions that affect the reflective processes and influence the different categories of cognitive and animated behaviour. They also provide the regulatory patterns that create stability. For Fleishman et al., (1999) they are also related to performance. Generally, traits may be taken as variables and the values/states that they adopt may be called types (Eysenck, 1957). In corporate theory the traits have generic characteristics that are domain dependent, and may be seen as normative personality variables that regulate the importance attributed to different classes of information. They are indicative of personality styles that arise from a combination of personality types, and which suggest a collective agency’s expected behavioural orientation in relation to that class of information. The types have a special role in personality theory. They are deemed to be responsible for the patterns of behaviour that a personality generates. Patterns of behaviour are generically defined as an abstraction from a concrete form that keeps recurring in specific, non-arbitrary contexts. It is this very nature that enables an agency’s behaviour to be predicted, even when it comes to their interaction with personal and situational variables. Where it is possible to associate personalities with stable type preferences, a consistent connection to behaviour can be discerned (de Oliveira, 2008; Hyldegård, 2009).
Our intention is to develop a model that couples agency socio-cognitive principles with traits to provide a generic cybernetic theory of organisations as collective agents. To formulate a model that will satisfy our needs will require that niche and/or subject domain boundaries must be crossed, and hence a meta-framework to enable this to occur. Meta-logic arises from a meta-framework that provides the capability of reflecting “a theory of meaning” through its meta-theory so that it can respond to both theory-doctrine and problem based issues (Oakley 2004), and it is through the constraining influence of context that a theoretical framework arises. Meta-theory may be seen as having three dimensions: it acts to connect different mid-range theories (Bacharach, 1989); it improves parsimony by accounting for a broader array of phenomena with fewer constructs than was previously possible (Tybout, 1995; Morgan & Hunt, 1994); and it generates new knowledge (Kaplan, 1964) by producing new empirically testable hypotheses. Realist meta-theory is unitary and concerned with principles from which particular theory can develop, as in the case of Bandura’s (1986) Social Cognitive Theory. Relativist meta-theory is pluralistic, connecting different relatable theories (e.g., Jackson & Keys, 1984; Jackson, 1991; Adams & Hyon, 2005). Relativist meta-theory building needs principles that can distinguish between paradigmatic differences, similarities, and interrelationships to be comprehended (Gioia & Pitre, 1990). There a number of meta-frameworks such as Managerial Cybernetics (Beer 1981), Complexity Theory (Prigogine and Stengers 1984; Hemaspaandra and Oghara 2002) and Knowledge Cybernetics (Yolles 2006). In this paper we shall adopt Knowledge Cybernetics due to its proven record of migrating knowledge from distinct domains of theory (Yolles 2010), and its broad capacity to conceptualise personality (Yolles, 2009; Yolles and Fink, 2009).

Cybernetics (Ashby 1956) is concerned with the control and communication features of coherently controlled (systemic) structures and their regulation that are essential to all social contexts. The modern cybernetics of viable systems is in particular concerned with “circular causality”, illustrated by the action of an autonomous human activity system that interacts with an environment and that may be responsible for change. Informal feedback may either confirm actual behaviour or make changes necessary. Imperative structural adjustments, in turn, can affect the way the system then behaves. A limited use of cybernetics in organisation theory was popularized by Argyris and Schön (1978) through their single and double loop learning. However, it has been the rise of the complexity view has made cybernetics attractive. Such work is illustrated, for instance, by Beer (1989, 1994), who argues for the need of explicit examination of control and communication within organisational situations that enable organisations to maintain their viability. Schwarz’s (1997) innovative condensation of the complex view of system viability through his Viable Systems Theory also intends to explain
how viable systems adapt and change in complex situations. This has been
developed on by Yolles (2006) in particular for human agency through an
approach called Knowledge Cybernetics (KC). This is one of the few approaches
that can enable a detailed geometric explanation of complex modes of being. It has
been developed for social knowledge based contexts integrating theory from
Habermas (1970, 1974), Piaget (1950) and others. It is also a meta-framework that
can respond to the apparent current limitations of organisation theory. It entertains
properties like self-regulation, self-reflection, self-organisation and their
connections to adaptation.

Modelling Collective Agency
All human agencies operate through worldviews that are linked with perception
and are responsible for perspectives. In the case of the collective, the worldview
often becomes formalized into a paradigm (Yolles, 2010a; Fink & Yolles, 2011). This
can be taken as the modus operandi of the collective, and its structure is
representative of that of the collective agency. Here, a paradigm that represents the
collective agency can be seen to have three ontologically distinct components: (i) A
collective cognitive base that constitutes an information pattern of the “truths” that
form both its epistemic base (deriving form the scientific beliefs that form patterns of
analytic knowledge) and its cultural base (deriving from the cultural beliefs that
arise as normative standards of conduct). Both are connected with assumptions,
beliefs and trusted propositions that arise within cultural development. The
cognitive base may be seen as the informative result of cybernetic interaction
(Maturana and Varela, 1987: 75) between the patterns of cultural and analytic
knowledge, and these affect each other through their history of mutual influence,
where cognitive intention plays a metasystemic role (Yang et al, 2009); (ii) A figurative
base that is composed of relationships that can be construed as information rich
conceptual models sedimented from its cognitive base, with connection to
cognitive purpose; (ii) A pragmatic base that is constituted by its normative modes
of practice that respond to standards of validity that constitutes evidence, with
connection to cognitive interest. Thus, a paradigm, far from being a disembodied
entity, is a cognitive map that is carried by a dynamic autonomous human activity
group and is responsible for its cognitive, figurative, and pragmatic bases.

Human agencies also function with intelligence, which is closely linked with the
ability to discern attributes of cultural knowledge, to efficiently and effectively
discriminate, relate, manipulate and apply that knowledge in a variety of
phenomenal environments (Yolles, 2006: 287), and to create inferences, and make
effective decisions (Bourdieu, 1984; Gardner, 1983 &; 1993; Pôr, 1995; Atlee and
Zubizarreta, 2003). For Piaget (1963) intelligence is the ability of an agency to adapt
to its immediate environment, and while this occurs in the individual, collective
intelligence can develop in kinship systems. Such adaptation occurs because an agency develops its intellect through figurative schemas that are changed with a learning process, and two forms of adaptation occur: assimilation (new information and experiences are fitted into existing schemas) and accommodation (schemas are changed when new information cannot be assimilated). Two forms of intelligence are proposed by Piaget (1950): operative and figurative. **Figurative intelligence** provides an agency’s core relational explanations of reality, and **operative intelligence** provides for its capacity to evidence its figurative base. Collective agencies with poor figurative intelligence do not maintain good representation of their environmental experiences in their figurative or cognitive bases. Those with poor operative intelligence cannot adequately manifest elements of their figurative base pragmatically, so that they have limited capacity to evidence models. Hence figurative and operative intelligence are intimately connected.\(^6\)

The cognitive, figurative and pragmatic bases of a collective agency together, through the intelligences, interactively contribute to its nature as reflected in its paradigm. Figure 1 illustrates this, created from the principles embedded in Knowledge Cybernetics. This uses a generic cybernetic model that maintains some core principles originating from Schwarz (1999), and draws on some of the nature of organisation theory as defined by Hatch and Cunliffe (2006). They distinguish five major fields of organisation theory, which are supposed to be somehow related to each other, though no specific model of these relations was developed. The five fields are: organisational culture and identity, organisational strategy, organisational design and structure, organisational behaviour and performance, strategic response to organisational environment. So there is a need to set the scene for a flexible organisation theory platform, which defines the domains and processes of organisations in a coherent systemic context. This would require going beyond what is defined as organisational mechanisms (as for instance proposed by Pajunen, 2008) to explain organisational decline and turnaround. It has to provide a powerful, extensible construct for modelling that is able to respond to queries about problem situations.

The generic model for the organisation in Figure 1 also adopts the concepts by Piaget (1950) of **internalisation, externalisation, and socialisation** that he adopted for child development, with Nonaka and Takuechi (1995) addition of **combination** in their organisational learning theory. Internalisation and externalisation together with combination constitute transitive connections across domains. The term **socialisation** is distinct in that operates through a (lateral, within domain) structural coupling process that lies outside the normative personality. The bars lying across the connecting **intelligence** loops illustrate the possible pathologies that might arise in the organisation, a notion we shall return to in due course.
Figure 1: Generic Model of a Collective agency drawing on Hatch and Cunliffe (2006) and Nonaka and Takeuchi (1995) also showing the operative systems of a connected agency.
It is also appropriate to comment here on the connection between organisational structure and operations. The question arises, is externalisation connected to structure, to operations, or to the structural coupling that exists between them? Phenomena must perhaps be represented as operational behaviour since structure as such is “phenomenally figurative” and cannot be directly observed. Organisational structure also acts to constrain and facilitate operations, this connection indicated by the structural coupling between the two. In other words, performance may be indicative that a structural adjustment is required, especially if unexpected patterns of performance appear. Any such adjustment reflects on the need to adjust patterns of behaviour.

**Normative Personality as a Socio-cognitive Model**

The noumenal domain of Figure 1 centres on information processes, and thus is constituted as the cognitive part of the organisation. As such we identify that this is the seat of any emergent normative personality system that may emerge, and it is our intention to model this.

In the socio-cognitive theory of the individual personality, the mind operates as a complex system (Bandura 1999; Cervone et al. 2004). Socio-cognitive variables develop through socio-cultural experiences. They distinguish between cognitive capacities that contribute to personality functioning, including skills, competencies, knowledge structures that have been sedimented from the real life situations that have been experienced, self-reflective processes that enable people to develop beliefs about themselves within social contexts, and self-regulatory processes where people formulate goals, standards and motivations toward identifiable outcomes (Bandura 1986, 1999; Williams 1992). Personality assessment differentiates between personality structures and behavioural orientations. The internal structures are assessed through an examination of a system of interacting psychological mechanisms rather than a set of independent variables as in trait approaches. In social-cognitive theory, assessments capture not only current psychological tendencies, but also personal determinants of action that contribute to development over the course of time. Evaluations are made of individual differences as well as the psychological attributes that contribute to personal identity. Ways in which the structures of personality come into play are illustrated as agencies interact with the settings and challenges that make up their day-to-day lives. Social-cognitive personality assessment seeks to explore agency personality coherence and the cognitive structures that are used to interpret events. They are also not only used to self-reflect and self-regulate, but also to change through self-organisation.

We recall Bandura’s interest in collective efficacy, and its capacity to control the emotive imperatives allowing an agency to, as a whole, attain goals and accomplish its desired tasks (Bandura, 1986 & 1991). It involves a perception that
efficacious collective actions are possible in relation to a social need. While this necessarily differs from the self-efficacy of the individual, the two concepts arise from the same origin. A difference between self-efficacy and collective efficacy distinguishes between cultural cohesion and the differences that exist between the agency members that compose the collective. The degree of cultural cohesion that an agency has can in turn influence the development of collective cognitive cohesion or dissonance (Brehm & Cohen, 1962; Greenwald, 1980; Fraser-Mackenzie & Dror, 2009), an unpleasant state of arousal that occurs when an agency becomes aware of attitudinal and behavioural inconsistency that have their original in a perception of cultural incoherence (Leontovich, 2003). Thus, for instance, a problem of normative culture can influence collective cognitive cohesion that in turn may affect normative performance through an agency’s lack of confidence and/or perceptual differences in collective efficacy (Bandura, 1995). The efficacy of a collective agency will also influence its ability to communicate, goal set, and persevere during adversity.

It is clear then that personality theory created for the collective agency has additional caveats to that of the individual as an agency. A collective agency may behave independently from the individual agents that compose it because the normative anchors for social behaviour may be different from the anchors of individual agent behaviour, as has been shown by the literature on Strategic Groups (Fiegenbaum and Thomas 1995); Herding (Hirshleifer and Teoh 2003; Welch 2000); and Groupthink (Janis 1972).

In order to understand more about the normative personality, we may find some direction from theories of the individual personality. There is support for this from a number of sources (e.g. Weik and Roberts, 1993; Bandura, 1999; Hofstede et al., 2002; Brown, 1961; Gindis, 2009; Barley, 2007), with collective agencies behaving consistently as “legal corporate persons”, and with a unitary rationality that can be explained. In Figure 2 we offer a model of normative personality that is socio-cognitive in nature. Performance involves the evaluation of directed behaviour, and is related to the interaction between the behaviours which are embedded in personality structures and the social environmental factors with which it is coupled. It is instructive to relate Figures 1 and 2, the latter in principle arising from the recursive application of Figure 1, where the domain meanings are contextually adjusted. Due of its systemic orientation, Figure 2 defines the normative personality in terms of a set of personality subsystems. Personality is cognitive and hence is constituted in terms of three classes of information that are expressed as meta/systems: conceptual information (object oriented beliefs and attitudes that through the system trait creates a cognitive orientation), figurative information (that is associated with appreciative information and decision imperatives that through the system trait creates a figurative orientation) and operative information (with its
structural and action information that through its system trait creates an operative orientation.

Figure 2: Normative Personality as a Cognitive System with Figurative and Operative Intelligences, seated in the noumenal domain of the Organisational Agency
A Basis for Coupling Agency and Trait Theory

The model that we shall develop here relates to the metaphorical arguments of Van Egeren (2009) in his cybernetic discussion of agency traits, but they take a more formal route. Bandura’s (1986) socio-cognitive theory arises through his notions of social learning, and he recognised that socio-cognitive processes are influenced by memory and emotions, and interactive with environmental influences. Behaviour is also seen to be guided by cognitive processes (like the Jungian types of thinking and judging). Bandura developed a theory of self that explored the complex psychological and subjective reality of individuals as it impacts on goals and expectations and points towards individual strategies that are used satisfy expectations and accomplish meaningful subjective goals, and it induces the affective representation of the perceived problem (Scott-Murray, 2005). It can be seen as a theory of individual differences (Bandura 1999), that recognises that processes are connected with personality traits that condition personality processes in some invisible way. However, he recognises that they are descriptive behavioural clusters that tell one little about the determinants and regulative structures governing the behaviours that constitute a particular cluster. In his view, for this there is a need for process theory in which can be explored self-efficacy. Self-efficacy beliefs determine how an agency feels, thinks, motivates itself and behaves. The beliefs produce diverse effects through the major processes of cognition, motivation, effectiveness and selection. In contrast to Bandura’s expressed limited understanding of the function of traits, Van Egeren (2009) and Davis (2002) have found that traits have a fundamental control and characterising function in the personality. However, it needs to be recognized that the regulative control function, which is unique for each trait, is constituted by distinct frameworks of principles that offers domination and functional governance.

In personality theory, a trait is usually seen as a distinguishing feature, characteristic or quality of a personality style, creating a predisposition for a personality to respond in a particular way to a broad range of situations (Allport, 1961). Traits are described as enduring patterns of perceiving, relating to, and thinking about the environment and oneself that are exhibited in a wide range of social and personal contexts; they are also habitual patterns of thought, emotion and stable clusters of behaviour. Traits also operate as continuous dimensions that together may define a personality space. The trait variables may in theory be subject to small degrees of continuous variation. For Eysenck (1957), the scalar value that a trait variable takes may be classed as a personality type (hence type-value), and there are various manifestations of types in trait theory (Goldberg, 1993; Costa and McCrae, 1992; Heinström, 2003). Traits may be inferred in personality theories that explore types.
It is possible to summarise the relationship between socio-cognitive, trait and type tendencies in the predominant species of theories, as shown in Table 1. Support for such distinctions might be read into Cervone et al. (2001), who notes that a social-cognitive approach to personality yields a theory of personality assessment that differs significantly from the trait assessment strategy that has so far predominated in the field. Connecting species of theories is not unknown, as illustrated by Eysenck (1957) who created a trait theory in which trait variables were able to adopt type states, and by Van Egeren (2009) who explored how socio-cognitive theories may be expressed in terms of traits. He uses his cybernetic control model to recast and reinterpret personality traits as predispositions that regulate goal-directed actions in particular ways characteristic of the individual (Van Egeren, 2009: 94). As such, a trait describes individual differences in how people tend to carry out tasks.

According to Bandura (1999) “supertraits” form the basic structure of personality. In contrast, Van Egeren (2009) uses the term “global traits” to mean the same thing. Since these traits form the regulatory mechanisms of the personality domains, we call them formative traits. Bandura recognises that different authors see different sets of formative traits (Barrett & Klein, 1982). For instance a sevenfold set is suggested by Tellegen & Waller (1987), a sixfold set by Jackson, Ashton, & Tomes (1996), a fivefold set by McCrae & Costa (1997), a threefold set by Eysenck (1991), a twofold set by Digman (1997). This diverse collection suggests that the number of traits selected is arbitrary if they do not derive from a generic model that demands certain characteristics, a notion supported by Van Egeren (2009).

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<th>Characteristics</th>
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<th>Traits</th>
<th>Types</th>
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Table 1: Overview of Major Theory Tendencies in Personality Theories
Formative Trait Schemas

At this point in the paper, it is appropriate to recall our interest in developing a generic model of organisational personality. Just as there is a plurality of unconnected and unrelated organisational theories (Suddaby et al., 2008), there is also a plurality of personality schemas that have little or no common connection (Carver, 2005). Consider that a set of formative personality traits can arise from core properties that commonly exist in relation to the capacity of a collective agency to survive efficaciously. They establish stable regulatory processes that enable the emergence of stable patterns of behaviour. Different traits therefore have different regulatory functions and hence necessarily reflect different characteristics. Therefore it is not too relevant how the names of these traits vary, so long as their characteristics can be related. This has been illustrated by Yolles (2009) and Yolles and Fink (2009), where trait schemas have been set into a characteristics typology and compared and related.

Personality interacts with its environment, and because of this we need also to consider influences that are exercised from the environment on the agency. We may distinguish two environmental traits: agency cultural and social orientation. Agency cultural orientation regulates what is legitimate in the agency, while social orientation regulates how the agency reacts to the perceived needs of others.

Let us propose that a set of normative personality formative traits can arise from core properties that commonly exist within the agency in relation to its capacity to survive efficaciously in its environment. In respect of our modelling approach, we shall identify three ontologically distinct formative personality traits (the cognitive orientation of integrativity, the figurative orientation of appreciativeness and operative orientation of viability), one additional agency formative trait (agency cultural orientation), and two agency environmental traits (social and ambient culture orientations). At this stage we are not interested in ambient cultural orientation. These traits are represented in Figure 3. The proposed characteristic natures of each of the five traits are fixed and indicated by each of the orientations (cultural, cognitive, figurative and operative). However, we have given the personality orientations arbitrary names that have a rational basis from which their definitions arise as follows:

**Cultural orientation** is a trait that is part of the cultural metasystem of the agency. It maintains three forms of knowledge: identification, elaborating and executor knowledge (Yolles, 2006) that can each be manifested into the personality system as information. The enantiomer type-values of this trait have been explored at some length in Yolles et al (2008) and arise from the work of Sorokin between 1939 and 1942, and summarised in Sorokin (1962). Form this we can distinguish between two orientations: sensate (with a tendency towards the materialistic) and ideational (with a tendency towards the spiritual). The type-values that this trait
can assume includes sensate orientation, which allows realities to be deemed to exist only if they can be sensorially perceived. Sensate type members of a culture do not seek or believe in a super-sensory reality, and are agnostic towards the world beyond any current sensory capacity of perception. Needs and aims are mainly physical primarily satisfying the sense organs and frequently materialistic. The epistemic attributes include: appreciating the nature of the needs and ends that are to be satisfied, the degree of strength in pursuit of those needs, and the methods of satisfaction. The means of satisfaction occurs not through adaptation or modification of human beings, but through the exploitation of the external world. It is thus practically orientated, with emphasis on human external needs. With reality as perceived from senses, its operative nature is highlighted in that it views reality through what can be measured and observed rather than reasoned. Cultural orientation may also assume ideational orientation, which sees reality as non-sensate, nonmaterial and frequently spiritual. Epistemological needs and ends are mainly spiritual, rather than practicable, and internal rather than external. The method of fulfilment or realization is self imposed minimization or elimination of most physical needs, to promote the greater development of the human being as a Being. Spiritual needs are thus at the forefront of this disposition’s aims rather than human physical needs. These enantiomer types act as yin-yang forces that together create what Sorokin (1962, vol. 4, p.590) called the Principle of Immanent Change. In this, autonomous agencies with coherent cultures experience cultural change by virtue of its own internal forces and properties. The principle of immanent change means that an agency cannot help changing even if all external conditions are constant. Sorokin (1962, vol. 4, p.600-1) tells us that any functional sociocultural system incessantly generates consequences that are not the results of the external factors to the system, but the consequences of the existence of the system and of its activities. As such they are necessarily imputed to it, and this occurs without the benefit of conscious decision. One of the specific forms of this immanent generation of consequences is an incessant change of the system itself, due to its existence and activity. The dynamics of change thus occur naturally as an internal process to the culture. While Sorokin was interested in large scale cultures which change over the long periods of time, smaller scale cultures like those of corporate agencies having small scale cultures may have an immanent dynamic that changes over small time scales. Due to the intimate relationship between culture and personality, cultural orientation changes must necessarily be reflected through change in attitudes and emotive imperatives in the normative personality.
Figure 3: Socio-cognitive Five Trait Agency Model connecting the personality trait model with its social and cultural systems.

**Cognitive orientation - Integrativity** is a cognitive orientation trait that arises from cognitive and social psychology (Van Liere & Dunlap, 1981; Menary, 2009), is existentially connected with cognitive self-reference (Hannah et al, 2008 & 2010), and maintains a relationship with cognitive intention (Freeman, 2008). Taken as a trait variable, it might involve the effective realising of potential recognising social and political structures and the associated constraints imposed on the agency. The
variable may be seen to take enantiomer type-values that give the agency an autonomy orientation when an agency will follow less the guidance of its host culture, but might react more autonomously to the lessons drawn from (or opportunities offered by) environmental impulses. The other enantiomer type-value of the variable might be embeddedness orientation, where a similar construct can be found in Sagiv and Schwartz (2007). The trait is affected by attitudes, and emotive imperatives that may orientate the agency towards cognitive coherence or dissonance. Integrativity has impact on perspectives that are associated with strategies, ideology and ethics/morality. It also creates imperative for the regulation of the patterns of behaviour through intention. This trait affects the operative couple between the appreciativeness and viability traits through its network of processes. This network has an efficacy orientation that affects an agency’s ability to manifest information through the creation of an emotive bias. However, it can also be seen in terms of directly affecting the viability trait (Figure 3) thereby contributing to cognitive coherence. This is connected with a move towards homeostasis - the human capacity to maintain or restore some physiological, psychological, or psychosocial constants despite outside environmental variations (Pasquier et al, 2006). The development of inefficacy can similarly lead to lack of coherence and a demonstration of collective cognitive dissonance, and this can act as a driver for cognitive state/dispositional dysfunctions (Endler & Summerfield, 1995: 255).

**Figurative orientation - Appreciativeness** (adapted from Vickers, 1965) is a figurative orientation trait, has both cognitive and evaluative aspects, is influenced by attitudes and reflection, and connects with cognitive purpose and processes of cognitive self-regulation. As a trait variable it might take enantiomer type-values that define a harmony orientation or an achievement orientation relating to the appreciations or goals. This may also be related to the notions of harmony and mastery by Sagiv and Schwartz (2007). We could further relate this to appreciations driving goal formulation as a process that derives from data collection and involving the careful weighing of arguments as opposed to spontaneous decisions following from the spontaneous desires of the decision makers. This trait maintains an interconnected set of more or less tacit standards which order and value experience, determines the way an agency sees and values different situations, and how instrumental judgements are made and action is taken. The trait facilitates how an agency as a decision maker observes and interprets reality, and establishes decision imperatives about it. As such the trait regulates the appreciations and resulting goals of the organisation with respect to its intended operations, the potential for social interaction, and the ethical positioning that may occur as a response to opportunities provided or indicated by the social environment. Efficacy in this trait in relation to the viability trait can lead
to self-principled agencies with aesthetical, intuitive or ethical/ideological positioning. It can provide preferred ideological images that may facilitate action. It orientates the agency towards a view of stages of historical development, with respect to interaction with the external environment. In-efficacy can lead to corrupt and sociopathic organisations (Yolles, 2009a), or more broadly agency misconduct (Greve et al., 2010).

**Operative orientation - Viability** (Beer, 1979) is an operative orientation trait that provides the ability of an agency to be able to durably maintain a separate operative existence while coping with unpredictable futures. As a trait variable it is able to take one of two enantiomer type-values. One constitutes a *flexible orientation* to effectively respond to environmental challenges or those that emerge from the social system. It is consistent with liberation away from regulatory power and bureaucracy. The other enantiomer is the *adherence orientation* to proven rules that relates to efficient decision making, and is consistent with the subordination to hierarchy. Challenges from the social system may require flexibility in the application of these rules. Through this the *viability* trait can represent a durable and distinct personality orientation that is able to cope with unpredictable futures. It structures appreciative information enabling adaptation, and enables the personality to facilitate responses to its social environment and predefine its behavioural penchant towards its operations. Agency *efficacy* in relation to the social orientation trait may contribute to the realising of its full social orientation potential, to engage with the environmental predictions that it controls, and adjust its own operative processes. In contrast, in-efficacy may result in an agency inadequacy that can impact on its operative intelligence or the recognition of agency adjustment imperatives. This may occur through self-regulation and either the subordination to hierarchy or liberation away from power and bureaucratic regulations allowing normative rule obedience to be defined at a sub-agency level.

**Social orientation** is a trait that operates in a given social environment. This might be seen to exist in a social operative system directed towards action, interaction, and reaction that (re)constitutes the cultural environment in terms of (desired, welcome, undesired, not welcome) activities. So, an agency might put emphasis on action (where its membership is convinced that it will get positive feedback, their product will sell etc.), or have a more observation orientation and collect (lots of) information before engaging in action. As a result its enantiomer type-values might define an *action orientation* that arises from an optimistic tendency, while its opposing *observation orientation* arises from a precautious or pessimistic tendency. It is worth noting that the efficacy of the social intelligences can also affect social orientation.
In Figure 3 we note that the integrativity trait acts to constrain personality through normative self-reference and identity. More, the appreciative trait is concerned with normative self-regulation, and the viability trait is concerned with normative self-organisation - and the two together constitute a first order operative couple. There is also a second order figurative couple that links the operative couple with its cultural environment and involves identity and self-reference.

In addition two other traits are introduced that are external to the personality, but which have an intimate relationship with it within the agency. These are cultural and social orientation. Cultural orientation refers to agency culture, but this is in itself influenced by the ambient host culture in which the agency is embedded. Social orientation is an extension of the agency personality that orients it within the social environment that hosts it. Both cultural and social traits are therefore part of the agency personality environment, and both are able to represent changing contexts that influence personality.

While it seems axiomatic that organisations wish to be durable and hence maintain viability, be able to assess what their requirements are and hence engage in appreciatively, and try to be coherent in their processes that engaging with integrativity, there is no research that explores these notions as trait variables. As arbitrary as this selection of traits may seem, they do conform to the principle that we have already indicated - that all traits have unique characteristic control functions. These unique characteristics are ontologically distinguishable as shown in Figure 3, as an elaboration of Figure 2.

**Intelligences and Efficacy in the Collective Agency**

We can represent Piaget’s operative intelligence, using Bandura’s terminology, as having the efficacious capacity of a collective agency to create a cycle of activity that manifests figurative objects as operative objects. In other words, operative intelligence occurs in a personality as the capacity of a network of processes to efficaciously migrate through semantic channels appropriate information content between two analytically distinct trait systems, in relation to the beliefs that the agency has in this regard. In contrast to intelligence, efficacy is the result of control on emotive weightings that are applied to the manifestation of distinct types of information by the intelligences, often summed up through the word *capability*. Associated with emotive control, it may result in positive-negative mood, optimistic-pessimistic outlook, or low-high levels of self-esteem (Strelau, 2002). It can affect perspectives and outlook, and under certain conditions inefficacy may develop as a pathology resulting in neurosis, as shown in Figure 3 ($P_{i,j}$), where it conditions the intelligences. Other attributes that can factor pathologies include intelligence limitation, which occurs when the selection of information to be manifested by the intelligences may become uncoupled from the preferences and unrepresentative of the intended perspectives. Yet another cause
may be semantic blocks (that may be related to extreme inefficacy and even cognitive dissonance) that inhibit the manifestation of information though the intelligences.

So, operative intelligence can be conditioned such that the ability of a personality to efficaciously migrate appreciatives trait information as imperatives for the viability trait is impaired, and vice versa. The personality metasystem is connected with this personality operative intelligence by figurative integrative intelligence. This can be thought of as a network of meta-processes or cognitive principles that efficaciously enables and contextualizes operative intelligence. It also connects identity with self-processes, a notion indirectly supported by Markus and Nurius (1986) who proposed a theory of “possible selves” which explains how the agency develops a connection between present self, motivation, behaviour and possible or future self. In addition it connects with Identity Process Theory (Breakwell, 1986 and 1988; Sullivan 2000; Twigger-Ross et al., 2003) where the conceptualization of identity is seen to involve four distinct principles of identity (self-esteem, self-efficacy, distinctiveness and continuity) that together enable the maintenance of a positive self-view.

As we show in Figure 3, the coupling connections between personality and the social system is referred to as operative social intelligence, and is the network of operative processes that enables a personality to manifest its decisions from its viability trait to be manifested socially. Indeed, as far as other personalities in the social environment are concerned, the only trait that is visible is that of viability. The coupling between the cultural environment and operative social intelligence (the latter occurring as a migratory dialogue between the personality and the social) occurs through figurative intelligenceviii.

The notion of cultural intelligence connects the integrative trait with operative intelligence, and in its original meaning is defined as the ability for an agency to successfully adapt to a change in cultural settings attributable to cultural context (Earley and Ang, 2003: 3; Thamas and Inkson, 2009). This definition requires a plurality of cultural beliefs, attitudes and values, which are in interaction and create a plural figurative base that has some level of cultural conflict within it. However, in the case where there is no such conflict, then cultural intelligence simply reduces to “the manifestation of the figurative base as patterns of cultural knowledge”.

We have indicated that operative intelligence may be seen as having the capacity to migrate information between analytically distinct trait systems of the personality. Operative intelligence is functionally constituted as a network processes that channel the migration of information semantically between trait systems. They occur with an efficacy status that conditions the intelligence by adjusting its emotive conditionix. While this should be more fundamentally connected with knowledge and understanding, efficacy is can condition the impact of emotive imperatives that may otherwise become overwhelming for an agency.
Efficiency also influences the capacity of the semantic channels through which the migrations occur, and this can influence the capacity of the interactive network of processes to manifest information between the appreciativeness and viability traits, or the viability trait as social action. This can impact on perspectivistic information as well as the capacity of the agency to undertake tasks efficiently, effectively or with optimal utility. Thus for instance according to Bandura (2006) high efficacy status allows impediments to achievement to be seen as surmountable by the improvement of self-regulatory skills and perseverant effort. They can also overcome vulnerability to stress and depression, and impact on the choices people make at important decisional points. However, it may also be envisaged that very high efficacy status can impact on motivation thereby affecting agency performance.

A collective agency is often interested in achievement represented by a given level of context specific performance. Performance is in part determined by the efficacy of the migrations of information between trait systems for given personality types. So any normative personality interested in changing preferences will also consistently want (at some preconscious level of awareness) to recognise that it may require an efficacy status change - that is, strong or weak efficacy. Such a change will have an impact on the semantic manifestation of information between the traits, controlling the orientation towards say the positive or the negative, the surmountable or insurmountable.

The nature of the model in Figure 3 supports the proposition that a normative personality is constituted through its traits, from which stable preference option types arise. We reiterate that while the traits are important, it turns out that the states that they take (which determine personality type) are fundamental to understanding the orientation of the personality (Yolles and Fink 2009) and hence towards an agency’s patterns of behaviour. Ultimately the personality types that an agency maintains is a reflection of its attitudes, emotive imperatives that are controlled by efficacy, and formative perspectivistic information, and it is these that determine what has epistemic value to the personality.

The notion of perspectivistic information is connected with perspective that arises from the ability of an agency to see and respond to an object of attention. For Piaget (1977: 87) the ability to conceive an object derives from the coordination of the schemes that underlie its activities with objects, and its objectivity derives from the coordination of perspectives. The coordination of perspectives originates cognitively through understanding generated from experience. Experience is filtered through and assimilated by available cognitive structures that both change and are changed by potential phenomenological inputs. The knower and the known are inextricably bound up with one another such that the object and the subject are inseparable. The acquisition of knowledge arises from the interaction between the object and the subject. It in particular involves both the operative functions relating to that which can be generalized, as opposed to figurative
functions that concern the specific nature of an external event. Piaget further asserts that all cognitions are inherently social. As such there is no distinction between social and non-social situations. The general coordination of actions provides the basis for cognitive structures, which are individual as well as interpersonal and social. However, these are influenced through the traits and their semantic relationships.

The traits are concerned with control and the epistemic attributes of a personality. The type-values that they adopt are normally a function of personality preferences that arise from espoused values, and result in requisite efficacy (the ability to achieve a preferred level of performance through the control of emotive imperatives that are best suited to create preferred achievements) through the manifestation of information between trait systems. An agency intuits/appreciates from these preferences what is requisite from its understanding of its environment in relation to the imperatives from its values and attitudes and other emotive imperatives, and this involves the use of its perspective. Preferences may also influence efficacy status and the nature of the intelligences.

Intelligence is concerned with the semantic manifestation of trait related information across domains using a network of internal processes. Taking into account the demands of its environmental context, if a collective agency has figurative information directly relating to an intention, aim or goal, then setting up an operative capacity to implement the plan viably requires a network of processes that can manifest figurative information operatively and meaningfully. Its capacity to do this is also influenced by the requisite efficacy through which the network of processes operates.

It is clear that personality orientations are connected to both intelligences and efficacy, and it is now possible to collect our discussions as a set of propositions appropriate to the normative personality. We have already indicated that personality orientation arises through personality preferences. In the agency cultural/knowledge metasystem, espoused values establish preferences, which are manifested in: (a) the cognitive metasystem of the personality as significant attitudes, preferences and connected feelings, (b) the figurative system as appreciative schemas, and (c) the operative systems as structural/behavioural imperatives. These manifested preferences determine the set of trait orientations of the personality that together create a personality orientation. Preferences are thus responsible for the nature of a personality, being influenced by both its intelligences and efficacy, and indeed pathologies and dysfunctions. Let us now summarise our postulated propositions.

*Intelligence* is constituted as a network of first and second order processes that couple two ontologically distinct trait systems. This network of processes manifests information through semantic channels thereby allowing local meaning to arise
from the manifested content in the receiving trait system. *Operative intelligence* is a first order form of autopoiesis that creates an *operative couple* between the figurative and operative systems. It consists of a network of personality processes that manifests significant figurative information operatively, but also it creates improvement imperatives to adjust the figurative system. This network of processes is itself defined by its appreciative schemas and decision imperatives in the figurative system and the improvement adjustment imperatives that arise from the operative system. *Figurative intelligence* is a second order form of autopoiesis (called autogenesis) that projects conceptual information into the operative couple. However, this couple also creates improvement imperatives to adjust the cognitive metasystem, from which figurative intelligence emanates in the first place. This metasystem is composed of attitudes, feelings and conceptual information that are harnessed to identify the network of meta-processes that define it, permitting significant conceptual information to be manifested in the operative couple. Intelligences are structured through personality perspectives and preferences. *Personality perspectives* arise in the personality meta-system from attitudes, feelings and conceptual information, and are influenced by the adjustment imperatives carried by figurative intelligence from the operative couple. The perspectives are manifested across the personality through perspectivistic information carried by its intelligences, to be integrated into schemas in the figurative system, and structured into the operative system. *Personality preferences* define a personality’s intended trait orientations, and as a variable this is determined by the type-value that the trait takes. The trait selection of type-value may itself be conditioned in some way by the information carried by the intelligences. The selection of information to be manifested by the intelligences may become uncoupled from the preferences and unrepresentative of the intended perspectives. This causes an *intelligence limitation* that can result in the development of *pathologies* (Figure 3) that affect the ability of trait systems to function. This lack of representation occurs because not all of the perspectivistic information is represented. Under such a condition the personality may: (1) have its capacity to conceptualise, schematise or apply perspectivistic information reduced; (2) have the orientation of its traits perturbed; and (3) be drawn towards un-preferred or unintended conduct that may even “corrupt” its proprietary strategic ideological or ethical orientations. Perspectives too may become adjusted through pathologic shifts in trait orientations.

*Efficacy* refers to agency capability resulting from the controls of emotive processes. It condition what the intelligences do by operating on the manifestations of information that occur between two trait systems, modifying the semantic channelling processes of the intelligences. It does this through the control of emotive impulses. Efficacy status occurs on a strong/weak scale that indicates the degree of efficacy/inefficacy that an agency has. High efficacy status allows impediments to achievement to be seen as surmountable by the improvement of self-
regulatory skills and perseverant effort. They can also overcome vulnerability to stress and depression, and impact on the choices people make at important decisional points. While rigidly high efficacy status can affect the capacity of an agency to create individual motivations that benefit its performance, low efficacy status can influence an agency’s ability to communicate, to develop appreciations, and to set goals and cite tasks. It happens because of the way efficacy conditions the manifestation process and hence drives both local development and the adjustment imperatives for improvement. As such it can affect an agency’s feeling, thinking, motivation, behaviour, and performance - including how it perseveres under adversity. Practically it is the capability efficacy that moderates the agency towards operative performance progression and hence achievement, and the adjustment imperatives that indicate the capability of this progression. The notion of capability efficacy assumes that every organization maintains some level of emotive impulse control, which might either dampen or enhance on the emotive impulses. Requisite efficacy occurs when the ability develops to achieve a level of performance through the control of emotive imperatives that are best suited to create preferred achievements. Requisite efficacy constitutes a desired efficacy which serves as a guideline for the agency. Pathologies may emerge when preferences restrain or exclude important knowledge flows or/and when the efficacy of knowledge flows is impeded. In both cases the agency is not in a position to follow its appreciations or achieve its own goals. If capability efficacy deviates from desired efficacy then the agency might consider some change in its pattern of behaviour or modify its appreciations or adapt its goals it wants to achieve. When preferences are perturbed, then a difference arises between requisite and capability efficacy, resulting in an efficacy distinction (ED) that contribute to the formation of pathologies indicate the limited capacity of the agency to generate requisite responses to its perceived needs for achievement under perceived environmental circumstances. The EDs of the intelligences shown in Figure 3 may result in pathologies. Given combinations of these across the personality may well generate distinct personality dysfunctions. If one considers that dysfunctions arise from standards of diagnosis, then one has to try to find out what pathologies result in which dysfunctions.

Pathologies $P_{ij}$ (Figure 3) occur in the manifestation of information between trait systems, and this impacts both the intelligences and efficacy. There is some evidence that combinations of these pathologies might lead to classical forms of agency dysfunction (Dauber, 2010), leading to the possibility of predicting pathology/dysfunction and/or preferences. Sperry (1995) has identified a number of classes of corporate dysfunction that include strategy/structure mismatch, structural problems, environmental problems, human resource problems, strategy/structure/culture problems, and a host of other problems that might be
better expressed as problems that occur under the umbrella of corporate personality disorder like corporate neurosis. This leads to the possibility of predicting dysfunction, and suggests a need to track the relationships between pathology combinations and dysfunctional agency classifications.

**Elaborating on Intelligences**

Our model contains four forms of intelligence: figurative and operative (and their connected emotional), cultural and social intelligence. In the literature we find a variety of attempts to measure organizational intelligence, which largely have no systematic link to most of the different classes of organization theory dealing with strategy, structure, operations, organizational culture or the organizational environment.

Piaget (1950) attempted to measure general intelligence in children using cognitive testing approaches to assess their concrete and formal operative strategies. In the context of children, the distinction between figurative and operative intelligence is simply shown in a map of cognitive development by Demetriou, Doise & Van Lijeshout (1998, p. 186). The Piaget tests were designed to look for particular types of understanding and/or reasoning (Bybee & Sund, 1982). Outside the child learning context the concepts of figurative and operative intelligence have not been used. Within the context of organization theory, an equivalent to Piaget’s examination of intelligence is the use of ethnographic methods. Interestingly however, operative and figurative intelligence may be connected with an empirical approach (based on a fluid mechanics metaphor from physics) that distinguished between fluid and crystalline intelligence (Hooper, Fitzgerald & Papalia, 1971; Schonfeld, 1986). Here, operative intelligence involves the fluid ability of logical thinking and the formulation and elaboration of relations, while figurative intelligence involves the crystallized ability of everyday learning that reflect recordable experience. Measures for both fluid and crystalline intelligences have been proposed by Cattell & Butcher (1968), Cattell (1971) and Cattell, Barton & Dielman (1972) that may contribute to a more comprehensive approach in measuring organizational intelligence.

Drawing away from this approach, a capacity to measure general organizational intelligence has been proposed by Albrecht (2003) and used by others (e.g., Yaghoubi, Moloudi & Haghi, 2010). Albrecht created a model of seven key dimensions of an organization, which were adopted as independent variables on which organizational intelligence depends. Gonyea & Kuh (2009) use three core dimensions of organizational intelligence. These have also been related to the notions of Erçetin et al. (2000) by Potas, Erçetin, & Koçak (2010). Kihlstrom & Cantor (2000) provide a useful review of the notion of social intelligence and its relation with other theoretical constructs. Thorndike’s (1920) sees social intelligence as the ability of an agent to perceive its own and others’ internal states,
mottives, and behaviours, and to act toward them in an appropriate way. Cantor and Kihlstrom (1987) define social intelligence in terms of an agent’s fund of knowledge about the social world, geared to solving the problems of social life and managing the life tasks, concerns or personal projects which an agent either selects or is assigned. Weinstein (1969) sees it as the ability to manipulate the responses of others. Kihlstrom & Cantor (2000) further argue that social intelligence cannot be evaluated abstractly, but rather with respect to context and in relation to the purposes it serves from the agent’s perspective.

Gilbert & Kottke (2009) adopt a model of social ability which has to include the core sub-dimensions of the concept of social intelligence, including social perceptiveness and social affordance seeking. Social perceptiveness is the capacity to be aware of the needs, goals, and feelings of others and the greater social environment, and this includes “multiple others” in the organization. High levels of social perceptiveness are useful for: accurately evaluating a social situation, determine the needs of the social context, and being aware of their social environment and of the intentions and sensitivities of others.

The concept of cultural intelligence (Earley, P. C., Ang, S., 2003) posits that understanding the impact of an individual’s cultural background on their behaviour is essential for effective business. Earley and Ang suggest that it is possible to measuring an individual’s ability to engage successfully in any environment or social setting and identified four basic aspects of cultural intelligence (see http://culturalq.com/fouraspects.html). Measures of cultural intelligence are provided by “The Cultural Intelligence Center” based in East Lansing, Michigan (http://culturalq.com/measure.html). These include the identification of intelligence as Cultural Quotients (CQ), and a number of dimensions of these have been proposed that include drive, knowledge, strategy, and action, which are defined below. CQ-Drive is the interest of an agent in experiencing other cultures and the extent to which one thinks to be capable of interacting effectively with people who have different cultural backgrounds. It includes: Intrinsic Interest - deriving enjoyment from culturally diverse experiences, Extrinsic Interest - gaining benefits from culturally diverse experiences, and self-efficacy - having the confidence to be effective in culturally diverse situations. CQ-Knowledge is an agent’s knowledge about how cultures are similar and how cultures are different. It includes: business - knowledge about economic and legal systems; interpersonal - knowledge about values, social interaction norms, and religious beliefs; socio-linguistics - knowledge about rules of languages and rules for expressing non-verbal behaviours. CQ-Strategy is how an agent makes sense of culturally diverse experiences. It occurs when people make judgments about their own thought processes and those of others. It includes: awareness - knowing about one’s existing cultural knowledge; planning - strategizing before a culturally diverse encounter; and checking - checking
assumptions and adjusting mental maps when actual experiences differ from expectations. CQ-Action is an agent’s capability to adapt verbal and nonverbal behaviour to make it appropriate to diverse cultures. It involves having a flexible repertoire of behavioural responses that suit a variety of situations. It includes: non-verbal - modifying non-verbal behaviours (e.g., gestures, facial expressions); verbal - modifying verbal behaviours (e.g., accent, tone).

We take emotions as states of mind, which are often associated with longer lasting mood, which we shall refer to as temperaments, and which are closely related to, though independent of, attitudes. Both can be seen as cultural knowledge based belief potentials that have been manifested as cognitive belief states in a personality that has an orientation towards some object of attention. The cultural elements from which emotions arise may be referred to as “emotional culture” that define the criteria of emotional competence that determines the self-regulation of emotions) and exposure to emotional episodes (Gordon 1989).

The intensity of this orientation is referred to as valence, which can be positive, neutral and negative (Hirschman & Stern, 1999). Temperaments and attitudes function with their own sphere of influence (Allen, Machleit and Klein, 1992: 492), and both have distinct affects on behaviour (Izard, 1977).

Temperament interacts with emotional activation or arousal (Hirschman & Stern (1999), citing Mehrabian and Russell, 1974). Emotional arousal is a relatively important area of study, in particular because of its perceived connection with memory in the individual. Thus for instance for Christianson (1992), perceptual, attentional, and elaborative cognitive processing - triggered by an emotionally arousing experience - can produce memory enhancements of details related to the emotion laden stimulus. The cost of this is less elaboration and consolidation of memory for the peripheral details. Positive temperament valence appears to enhance information processing ability (Isen, 1987) and reduce cognitive elaboration (Batra & Stayman, 1990), and the development of emotional arousal is connected with the processes through which information is encoded (Sharot & Phelps, 2004; Ochsner, 2000).

When temperament and emotional arousal interact, the result is emotional feelings like tranquillity, delight, melancholy or panic. Hirschman & Stern (1999) propose a model that represents this relationship. It is adapted from Holbrook and Batra (1987) with antecedence in Russell (1980), and relates temperament with arousal. An adapted form of the model, represented in Figure 4, distinguishes between four classes of emotional feeling, making it easier to discuss theoretically the role of emotional feeling in an agent than when having to deal with innumerable different feelings. We refer to these feeling classifications as: containment, stimulation, passive, and dysthymic. These can be seen as classes of feeling tendencies, developed through experiences of degrees of emotional arousal.
Hirschman & Stern (1999) note that an agent’s willingness to take emotional risks is dependent upon the temperament valence that they have at the time. Thus, durable positive valence in temperament, as believed by an agent, will likely result in the agent taking more emotional risks, and those who believe themselves to be in substantively dysthymic will make choices aimed at reducing emotional risks. Temperament interacts directly with attitudes, contributing to cognitive responses (e.g., attitude formation and recall) and behaviours. Thus Kahn & Isen (1993: 257) have found that temperament with positive valence improves an agent’s expectations about the likely outcome of anticipated neutral or positive experiences or events, and prompts it to engage in more elaboration and thinking about neutral things in which they are interested.

Figure 4: Classes of emotional feeling tendencies (containment, stimulation, passiveness, dysthymic) arising with the continuously variable variables of temperament valence and emotional activation/arousal (adapted from Hirschman & Stern, 1999: 8)
Even though collectives are composed of individuals, resulting in a supposition that normative and individual personalities operate in a similar way, there are distinctions between the individual and the collective (Yolles, 2009a). The substantive difference is that while individuals may adhere to organisational norms, organisations operate through collective norms that develop from their coherent cultures. Unlike that of the individual, organisational personality processes are often both observable and measurable. While the individual’s temperament, emotional feelings and emotional arousal will undoubtedly impact on the functioning of the organisation as a whole, normative emotional attributes (in the collective) will have a more profound influence on its overall functioning and coherence.

**Conclusion**

The intention in this paper has been to create a generic platform for the organisation as a psychosocial agency. As part of this, and as a means of reducing organisational complexity, we have formalised the idea of an emergent normative personality that comes into being when a durable collective develops a dominant culture and a paradigm which it maintains. A cybernetic socio-cognitive trait model has been developed that draws on Piaget’s concept of intelligence and Bandura’s concept of efficacy, and enables agency pathologies and dysfunctions to be explained in a new way. These can be factored through inefficacies, intelligence limitation, and semantic blocks that arise through cognitive dissonance possibly as a result of a lack of cultural cohesion.

Understanding organizational intelligence and efficacy, normative trait systems and their pathologies can lead to an improved understanding of the information processes that an organization has and how this affects its social behaviours. The theory that we have developed goes beyond the recognition by Van Egeren that traits may be viewed in terms of self-regulatory propensities or styles affecting how agents characteristically pursue their goals. Here, traits are seen as ontologically distinct, having different derivative natures. They have conceptual, figurative, operative, and event orientations. A network of processes is involved in migrating information from one trait to another. While the traits arise from a base of action related knowledge from which cognitive processes are derived, environmental orientation also has an embedded trait that is more connected with environmental knowledge relating to the structures, norms, and indicative behaviour observed there.

We have developed agency theory for normative personality to enable us to better understand the regulatory processes that occur within the organization, and this includes both traditional regulatory features that arise from socio-cognitive
theory like self-organization, self-reflection, self-reference and identity. Another form of regulation that exists occurs through personality traits that are responsible for stable patterns of conduct and behaviour. Given known contexts, particular instances of behavioural conduct are usually predictable. Stable patterns of behaviour are determined by the set of formative traits. In the modelling process here, we have recognized that organizations operate through formative orientation traits (cognitive, strategic, operative, etc.), and these have core characteristics. These orientation traits can be connected with other relatable theories, enabling us to provide an appreciation of recognizing patterns of behaviour and predicting instances of operative conduct and behaviour, and indeed misconduct.

The theory that we have developed goes beyond the recognition by Van Egeren that traits may be viewed in terms of self-regulatory propensities or styles affecting how agencies characteristically pursue their goals. Here, traits are seen as ontologically distinct, having different derivative natures. They have conceptual, figurative and event orientations and a network of processes are involved in migrating information from one trait to another. While the traits arise from a base of action related knowledge from which cognitive processes are derived, environmental orientation also has an embedded trait that is more connected with environmental knowledge relating to the structures observed there, norms, and indicative behaviour.

One of the conclusions drawn from the theory is that the type-value preferences of a normative personality not only determine its trait type-values (and thus the personality types), but ultimately impacts on its capacity to efficaciously service the information processes that are associated with the traits. A need in agency analysis is to determine whether the value preferences are requisite in relation to the agency’s environments and contexts, allowing pathologies to be explained. Requisite value preferences are central in that they determine whether particular organisational traits arise from preferences or rather from the pathologies that determine dysfunction. Another useful attribute is the analysis of an agency’s cultural and social intelligences, enabling determination of whether the organisation has an appropriate value preference set or not. All forms of intelligences taken together therefore provide a picture of the preconscious processes by which an agency operates.

References


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NOTES

1 Neurosis in psychology is a functional disorder in which feelings of anxiety, obsessional thoughts, compulsive acts, and physical complaints without “objective” evidence of disease, occur in various degrees and patterns, and dominate the personality. Following Strelau (2002), neuroticism (for which emotionality is used as the synonym) has the following components: anxiety, depression, guilt feelings, low self-esteem, and tension. The opposite pole of neuroticism is emotional stability. Psychoticism, the opposite of which is impulse control, consists of such primary traits as aggression, coldness, egocentrism, impersonality, and impulsiveness.

2 The success of Hofstede (1984, 1991, 2001) can be attributed to parsimony. From a complexity of descriptions, he sedimented four value dimensions, which help one to understand that culture has an influence on behaviour - although this is not done as directly as is implied by the notion ‘culture as the software of our minds’.

3 There are two forms of intelligences that are slightly adjusted from the notions proposed by Piaget. Operative intelligence provides information for the personality to assist it in its decision making operations, and thus relates to the potential for phenomenal and observable behaviour and “to what actually is happening.” It frames how the world is understood, and if understanding is not successful, operative intelligence is able to change. It does this through two forms of adjustment. Assimilation is the active transformation of information so that it may be integrated into already available mental schemes, while accommodation refers to the active transformation of the mental schemes to engage with the particularities of its environmental object of attention. Operative intelligence manifests figurative thematic information and decision imperatives through a selectable network of processes to the personality’s operative structures in relation to a specific environmental context. This plays a facilitating and condition role for any strategic, ethical or ideological decision behaviours that might develop. The figurative information comes from a set of figurative schemas like mental models and abstractions, and other forms of appreciative information and decision imperatives, and the operative information is set into operative personality structures that condition decision making behaviour. Operative intelligence manifests figurative information into the operative personality system to enable thematic decisions to be made in relation to interactions in the environment that facilitate behaviour. Operative adjustment imperatives to the figurative personality system are used to either re-emphasize available figurative images (including mental models and abstractions) or to adjust/reformulate figurative structures. Operative intelligence is a form of first order autopoiesis (Schwarz, 1997; Maturana and Varela, 1987) which explains how a “living system” self-produces its core relational explanations of reality that influence behaviour. This defines for the personality system its own boundaries relative to its environment, develops its own unifying operational code, implements its own programmes, reproduces its own elements in a closed circuit, obeys its own laws of behaviour, and potentially satisfies its own intentions (Jessup, 1990). It also self-produces the network of processes that enable it to produce its own personality components that exist in cognitive, figurative and operative bases. Figurative intelligence helps to construct strategic, ethical and ideological figurative schemas that defines a potential for decision making behaviour, and contributes to the solidification and formation of personality as a whole. It decides what kind of information assembled through operative intelligence will be considered to be conceptually significant and thematically relevant, or whether conceptual adjustments should be made to its patterns of knowledge in its cognitive base. Where conflicts arise, imperatives can be directed to the operative couple that are responded to by operative intelligence, enabling figurative and operative structures to be adjusted. Figurative intelligence can be taken as a form of second order autopoiesis called autogenesis (Schwarz, 1997) through a higher level of processes, that is, meta-processes that may be represented for instance as guiding personality convictions, principle influences, or even spirit. It occurs when a selectable network of these meta-processes is able to project into the operative couple a set of espoused values as attitudes and mental schemas and operative personality patterns. Figurative intelligence will reflect on operative couple information by relating it to its cognitive base and the patterns of feelings, beliefs and knowledge held there. It is thus able to integrate precise adjustment
imperatives into its cognitive base of information about states of reality provided by the operative couple. Figurative intelligence has the thematic responsibility of creating, through its information imperatives, a capacity by the figurative and operative bases to reflect the significant cognitive base elements for a given environmental context and interaction set. The notion of figurative intelligence developed here should be seen as a development of that proposed by Piaget. Rather than figurative intelligence being seen as a passive notion, we take it to be second order active by recognizing that its actions occur through a meta-dynamic that arises from a higher order coupling between a personality’s cognitive metasystem composed of attitudes and feelings and conceptual information, and operative couple involving operative intelligence. It is then responsible for the influence that is created by the network of cognitive principles that define “I”, and result in the agent’s own rules of personality production.

4 The term enantiomer (also enantiomorph that in particular relates to form or structure) means a mirror image of something, an opposite reflection. The term derives from the Greek enantios or "opposite," and is used in a number of contexts, including architecture, molecular physics, political theory, and computer system design. We use it in the sense of complementary polar opposites. The related word enantiodynamia is also a key Jungian concept used in his notions about consciousness (e.g., http://www.endless-knot.us/feature.html), and (from the OED Online) it is the process by which something becomes its opposite, and the subsequent interaction of the two: applied especially to the adoption by an individual or by a community, etc., of a set of beliefs, etc., opposite to those held at an earlier stage. For Jung the word enantiodynamia represents the superabundance of any force that inevitably produces its opposite. Consequently the word enantiodynamia often implies a dynamic process which is not necessarily implied by the word enantiomer. By using the simpler word enantiomer we shall not exclude the possibility of any dynamic action that may have been implied by the term enantiodynamia. For us, a trait develops enantiomers through traits that have either an operative or the figurative orientation.

5 Wullheim (1999) defined cognitive state in terms of impulses, perceptions and instincts, imaginings, and cognitive dispositional drives in terms of beliefs, knowledge, memories, abilities, phobias and obsessions. Mental disposition consists of beliefs, knowledge, memories, abilities, phobias and obsessions, and has duration and history. Both mental states and dispositions are causally related, mental state being able to instantiate, terminate, reinforce and attenuate mental disposition. Mental dispositions can also facilitate mental states.

6 The notion of migration is constructivist, and relates to the recognition that there is a distinct difference between knowledge, information and data (Biggiero, 2007). Migration has a lateral and transverse interpretation, though the latter involves the former. Consider an illustration of the lateral form: information migration (a notion that has also been discussed in other terms by Miller (1978) and Luhmann (1995)). This involves understanding the distinction between bound and free information. Information that arises from the interaction between specific phenomena and thematic knowledge becomes bound to the noumenon. Where this is to be communicated between two autonomous but thematically related agencies, messages are structured noumenally through the creation of free information that has the capability of entailing a description of bound information. The messages are communicated phenomannally through the creation as a set of coded signals that have the potential to create new bound information that when related to both the specific phenomena and thematic knowledge may be understood. The message is communicated laterally between the creating/transmitting and receiving/interpreting agencies. The transmitting agency locally constructs the coded signals from its free information to create the message, and the receiving agency locally deconstructs these and reconstructs the new free information that it now bounds to its noumenon through its thematic pattern of knowledge. Since the transmitting and receiving agencies are autonomous as are the construction and reconstruction processes, their respective free information is distinct. As a consequence, any attempt to relate the constructed and the deconstructed information in the source and sink agencies must involve some degree of uncertainty, which may be magnified as bound information. Consider now the transitive notion of ontological migration for the organisation as an agency with a personality that is separated into three ontologically distinct sets of generic (trait related) functions that deal respectively with conceptual, appreciative, and operative information.
Further consider that the agency is composed of a number of humanly populated autonomous
generic functions that are connected with each of these classes of information, and that there is an
interest in the agency to map information from a sub-agency concerned with only appreciative
information to one that is only concerned with operative information. This mapping requires a
network of processes that derives from the appreciative sub-agency as a source, and is delivered to
the operative sub-agency as the sink. Since the source and the sink sub-agencies are constituted as
different autonomous functional components of the agency, so the communication reduces to a
process of information migration. Ontological migrations thus define the symbolic capacity for the
transverse reality of one generically distinct sub-agency to be manifested in another, for example
through the creation of channels. In our models here, these channels exist as networks of first and
second order processes that have been respectively referred to as autopoiesis and autogenesis. In the
social psychological terms developed here these are respectively referred to as operative and
figurative intelligence.

7 The term figurative intelligence is generic to the model, but when migrating the concept from the
individual personality to the organisational level, it takes on a normative significance. Figurative
intelligence has the capacity to represent the cultural belief system (of values, attitudes and beliefs) as
a coalescence of normative ideological and ethical standards of the culture that ultimately defines
what it is that constitutes legitimate modes and means of pragmatic behaviour.

8 The explanation for this recognizes that agency traits are allocated to ontologically distinct systems
that are connected by intelligences. These intelligences are constituted as a network of processes that
manifest information between the trait systems. Bandura (2006: 165) explains that efficacy resides in
the minds of group members as the belief they have in common regarding their group’s capability,
and in a collectivity members acting on their common beliefs contribute to the transactional dynamics
that promote group attainments. The collective performance of a social system, he tells us, involves
interactive, coordinative, and synergistic dynamics that create emergent group-level properties not
reducible solely to individual attributes. Intelligence in an agency is a transaction dynamic that
contributes to coherence, and consists of a network of changing processes involving a complexity of
transactions used to manifest information between two trait systems. As such processes of intelligence
are subject to conditioning by people’s emotive impulses that need ideally to be controlled
efficaciously.

9 While values are culturally defined, according to Schein (1985) they are espoused when they can be
used to distinguish between observable and unobservable elements of culture.
Context-dependent modelling and anticipation the other coin of the system approach

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ABSTRACT

General Systems Theory (GST) and cybernetics bring new insight into the behaviour of complex systems. Simulation models, ICT and system approach methodology enable new possibilities in modelling the behaviour of social systems. System dynamics (SD) is an appropriate methodology for modelling and testing dynamic hypotheses. The Liege conferences: CASYS has important roll for the propagation of an anticipative approach to understanding behaviour of dynamic systems. One class of very important anticipative systems is organisation. This contribution intends to show the unity of context and SD methodology in the management of complex systems.

Keywords: System Dynamics, Simulation, Learning, Decision Support

1. INTRODUCTION

We are delighted to write the chapter dedicated in honour of Stig Holmberg for his achievements in the field of Information Systems and Decision Support. Since Norbert Wiener’s book Cybernetics and especially his second one Cybernetics and Society or Human Use of Human was published in 1948, views on the worth of human work have dramatically changed. Human work is no longer measured merely in mechanical units, but in information bit/seconds. More precisely, human work started to be estimated as a new added value in products; further, more holistically, as the overall new added value to society as consequence of societal innovations. This requires synergetic effects of particular aggregates in the whole of the regional economy as the part of the global economy. However, it implies high levels of education, research & development (R&D), organisational culture, culture, health care, preservation of environments, etc. as the conditio sine qua non for creativity, invention and innovation, and organisational learning. Only innovative organisation and society assures sustainable and safe development. To accomplish this vision-based approach (VBA) in complex systems, the main agent
is decision making supported with simulation models and ICT. This article is an essay on the anticipative approach to complex societal systems based on three pillars: ICT, System approach methodology, and modelling and simulation. General system theory and cybernetics bring new insight into the behaviour of complex systems. Simulation models, ICT and system approach methodology enable new possibility in modelling and understanding the behaviour of social systems. System dynamics is an appropriate method and tool for modelling and testing dynamic hypotheses. The Liege conference (CASYS) is the *spiritus agens* in propagation of the anticipative approach to understanding dynamic systems. A class of very important, so-called weak anticipative systems –model-based functioning systems (Dubois, 2000) – is an organisational system. Stig Holmberg gave relevant contributions to modelling very important real problems of societal systems using SD, and ICT on their anticipative solving (Holmberg et al, 2000). How prophetic and current was the article entitled “Simulation-Based Decision Processes for Territorial Security” (Dubois, 2010) in the light of a Japan’s recent earth quake and tsunami disaster.

The goal of this chapter is to highlight the present state and perspectives of the theory and practice of decision assessments in enterprises, and other complex systems, based on System Dynamics (SD) and simulation models. We will address the influence of feedback information on the group decision process supported by the application of the system dynamics models. In this research, we have addressed learning process, group dynamics and quality of decision-making. From the methodological perspective, we will demonstrate the connection with the general definition of SD methodology as well as the role of a subject in the process of modelling and the context of the problem.

2. **GENERAL APPROACH TO COMPLEX SYSTEMS MODELLING PARADIGM AND ROLE OF THE SUBJECT**

In order to clarify the assertion that modelling methodology is an inseparable part of the context of the problem and can be described from the different perspectives of a modeller, we will start with a general definition of the word “systems”. It is derived from ancient Greek and means a whole that consists of elements and is greater than the sum of its elements. An element is the smallest part of the whole, necessary for the system described, which cannot or will not be divided any further. From a formal point of view, a system is defined by the double

\[ S = (E, R) \]

(1)
where \( E_i \in E \subseteq U, i = 1, 2, \ldots, n \) represents the set of elements and \( R \subseteq E \times E \) the binary relation between the elements, and \( U \) the universal set. Each element \( E_i \in E \) can be further set as well and \( R_j \in R, j = 1, 2, \ldots, m \) defining different relations between the elements. For example relation \( R_j \) for each \( j = 1, 2, 3, \ldots, m \) reflects different connection among systems elements from energetic, material, production, electrical, chemical or information aspects etc. In general, three classes of complex systems can be identified: Natural Systems (mechanical systems), Biological Systems (living systems) and Organisational Systems (human systems). All have certain structural similarities, yet there are enormous differences in our understanding of their behaviour. We will consider Organisational Systems as complex because of the different relations among subsystems, such as psychological, social, political, material, financial, informational, etc. Their structure and functioning are changed because of changing relations among participants and the environment due to change in information technology. In this case, the information-based decision represents the prevalent force of development.

From the research perspective, human activity in order to gather new knowledge can be considered from two aspects: the subject of the research itself (process) and the methodology using different methods, tools and techniques for process analyses (Mingers, 2008). Research methods are sets of rule-based knowledge by which we can consistently describe some process described by Equation 1 or a test hypothesis. Therefore, there are many different approaches and consequently descriptions of such a system.

![Figure 1. Subjects in the modelling process](image)

There are three main concepts in the modelling approach to real world (Myers, 2009): a) Positivistic, which supposes that (1) the external world exists independently from the observer, (2) this world is not directly observable, and (3)
for its representation, we develop simplified models. b) Interpretative, which starts with the assumption that social reality is a social construct and its understanding and interpretation is only possible through language, consciousness and shared meanings. c) Critical, in which researchers assume that social reality (realised reality) is historically constituted and that it is produced and reproduced by people. This paradigm can be stated (Kljajić, 1994) with a triad \((O, S, M)\) in Figure 1. \(O\) represents the real object; \(S\) represents the observer (subject) and \(M\) the model of the object as the consequence of observed knowledge, intention, interest etc. The relation between the observer, \(S\), and the object, \(O\), is of essential significance. The observer is a person, with all his cognitive qualities, while the object of research is the manifested world, which exists by itself, regardless of how it can be described. The third article of the triad \(M\) is the consecutive one and represents a model or a picture of the analysed system \(O\). The \(O \leftrightarrow S\) relation in Figure 1 indicates the reflection of human experiences to concrete reality. This cognitive consciousness represents our mental model. The relationship \(M \leftrightarrow S\) represents the problem of knowledge presentation, i.e. the translation of the mental model into the actual model. The \(O \leftrightarrow M\) relation represents the phase of model validation or proof of correspondence between theory and practice, which renders possible the generalisation of experiences into rules and laws. The \(S \rightarrow O \rightarrow M\) relationship is simply an active relation of the subject in the phase of the object’s cognition. The \(M \rightarrow O \rightarrow S\) relation is the process of learning and generalisation. A theory is an intellectual construct enabling us to obtain a more generalised form of the phenomena of the research and direct results of the experiment. In the cognitive process, the value standpoints of subject \(S_v\) are far more important to us in relation to the object of research in the modelling process. This can be stated in the following equations: (2) and (3).

\[
S_v \cap (O \cap M) = 0 \tag{2}
\]

\[
S_v \cap (O \cap M) \neq 0 \tag{3}
\]

In the second parts of Equations (2) and (3), \(O \cap M \leq 1\) are always fulfilled. (In the case of \(O \cap M = 1\), the model and original are identical. This statement is valid for abstract, i.e. formal knowledge). Equation (2) is valid for formal and natural sciences, where \(S_v = \emptyset\) (empty set). This means that it is impossible to find any link between the axiom and the hypothesis linked to model \(M\) and the value standpoints of the subject. That is, of course, not valid for the scientific hypothesis in the process of modelling; this is always the product of the intellect and historically conditioned by the progress of science. Such hypotheses may always be rejected (Popper, 1973). In the case of organisational sciences and humanities in Equation (3), the value
standpoints of the researcher and the object of the research are always $S_r \neq \emptyset$. Some qualities, which are not provable, are always added to the description of the observer in question. The conditions expressed by (2) and (3) have a key meaning in the choice of research methodology and for the scientific value of the statement. The first expression allows the establishing of the principle testable hypothesis by means of active experiments with the subject, while the second cannot and is not allowed to prove the hypothesis through experimentation, but by observation and generalisation dependent on the qualities of the observer. This conclusion is similar to C. S. Peirce, (Peirce, 1931) and his three categories of being; *Firstness, Secondness*, and *Thirdness*. This means there is a triadic relation between the Sign, the Object, and the Interpretant. This triadic relation is not reducible to a set of dyadic relations between a sign and an object or between an object and an interpretant. Meaning is never reducible to *Firstness* or *Secondness*, but can always be found in genuine triadic relations. Only a subject gives real value and meaning to the model in the frame of a context (Jere Lazanski and Kljajić, 2006). From above elaboration, we can conclude that modelling is always context dependent, conditioned with the problem and the goal. The Subject, with his perception and perspective, has the main role in the modelling process. With complex systems, according Equation (3), the Systems approach is a holistic methodology to overcome different point perspectives of the modeller. With model-based control (weak anticipative systems) the Systems approach is other name for the process of modelling.

### 3. SYSTEM DYNAMICS FUNDAMENTALS

Fundamentals of System Dynamics were defined by J. Forrester in the mid-1950s as a method for the modelling of industrial dynamics. At the beginning of the 1980s, a time of rapid expansion of industrial IT, the method was renamed as System Dynamics (SD). The method is straightforward in its essence, based on the conservation of mass principle. Nevertheless, the genius of Forrester is that, as the pioneer of computer science noticed, the power of computers could be used in the business systems, not only for collecting, processing and storing data but also for the strategic decision making. For this, dynamic models of systems are needed. Consequently, a method of modelling was developed that is clear, straightforward, user friendly and holistic. J. W. Forrester developed the methodology and simulation tool, i.e. a program. The idea of modelling is based on the supposition that every real system, as well as the business system, could be described by the system of equations that is represented by the interconnected flows or Rates and Storages i.e. Levels:
\[ S = (L_j, R_i, A_r) \text{ } j = 1, 2, \ldots n, i = 1, 2, \ldots m, r = 1, 2, \ldots I \]  

(4)

Here \( L_j \) represents the set of Levels (stocks) and \( R_i \) the set of R (flows) and \( A_r \) the Auxiliary expression by which we can express arithmetic relation among \( L \) and \( R \). Each level, \( L \), or state element has its own input i.e. input rate \( \text{Rin} \) and its own output Rate, \( \text{Rout} \). Figure 1 shows symbolic representation of described elements.

The conservation of mass principle for the above model could be described by the dynamics equation in the form of difference equation:

\[ L(k+1) = L(k) + \Delta t(R_{\text{in}}(k) - R_{\text{out}}(k)) \quad k = 0, 1, 2, \ldots n \]  

(5)

where \( k \) represents discrete time, \( \Delta t \) is the time interval of computation. Each entrepreneur understands that the value of Level element \( L(k+1) \) increases if \( R_{\text{in}}(k) > R_{\text{out}}(k) \); it is unchanged if \( R_{\text{in}}(k) = R_{\text{out}}(k) \), and decreases if \( R_{\text{in}}(k) < R_{\text{out}}(k) \).

In Figure 2, \( P1 \) and \( P2 \) represent the decision parameters by which the flow, i.e. Rates, are regulated to and from the Level element. The clouds at the beginning and at the end represent the environment of the model. This is therefore our boundary of modelling of the addressed model. From the formal viewpoint, this method is indeed straightforward and clear, as well as understandable. In case of the concrete problem, possible mining of \( L \) and \( R \) elements are obtained. There are several methodologies for complex problem solving similar to System Dynamics, such as the System Approach, System Thinking etc.; these can be concisely described by the steps (Kljačić Fahr, 2010) shown in Table 1. Obviously, all three procedures are almost the same; small differences can be observed only on the lexical level. The first step is defining or stating problem, or describing the system. When we talk about the problem, we anticipate part of the process (or the systems)
with whose functioning or behaviour we are not satisfied. From an engineering perspective, it means deviation of the state of reference variables values. The next step is determination of the desired value of the state variables, i.e. the goal of the problem to be solved. Following this step is the dynamic hypothesis or a theory how to reach this goal, i.e. by changing parameters or structure of the systems (process part or control). Of course SD (or modelling in general) does not deal only with solving problems. Weak anticipation also means foreseeing potential problems and preventing undesired behaviour with different vision-based scenarios and structures.

Table 1. Comparison of system approach methodologies.

<table>
<thead>
<tr>
<th></th>
<th>SA (Klajić 1994)</th>
<th>SIMILAR (Bahill &amp; Gissing, 1998)</th>
<th>SD Forester (1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem definition</td>
<td>State the problem</td>
<td>Describe the system</td>
<td></td>
</tr>
<tr>
<td>Goals</td>
<td>Investigate alternatives</td>
<td>Convert description to L and R equations</td>
<td></td>
</tr>
<tr>
<td>Mathematical model</td>
<td>Model the system</td>
<td>Simulate the model</td>
<td></td>
</tr>
<tr>
<td>Computer program</td>
<td>Integrate</td>
<td>Design alternative polices and structures</td>
<td></td>
</tr>
<tr>
<td>Model validation</td>
<td>Launch the system</td>
<td>Educate and debate</td>
<td></td>
</tr>
<tr>
<td>Simulation scenarios</td>
<td>Assess performance</td>
<td>Implement changes in policies and structures</td>
<td></td>
</tr>
<tr>
<td>Simulation and analysis</td>
<td>Re-evaluate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The second step is determination of the goal states that should be achieved; this step is implicit in the first step. The next step (in SD) is converting the problem within the goal into L and R elements and their interconnection. With the application of the dynamic hypothesis, the dynamics of the system are determined as the consequence of key feedback loops in the system. In this phase, with complex problems, the key role is played by the team, using an interdisciplinary approach. State elements and their relations are nonetheless the main part of the analysis, which could be performed in several different ways. In the end, the validated model is the tool for the testing of the dynamic hypothesis at the different visions (scenarios). In order to address complex problems, one has to apply a systematic and team approach (Škraba et al., 2003, 2007) in the process of finding solution. In his methodology, Forrester emphasised the step “Educate and
debate”. Without users’ participation and their understanding of the problem in course of SD (or any other) methodology, there can be no successful results.

4. SIMULATION MODEL AS A TOOL FOR DECISION SUPPORT

The advantage of simulation model as a part of a system approach is in the fact that a problem defined in natural language can be easily transformed into a directed graph, convenient for qualitative and quantitative analysis in a computer program. In this case, the user can always check the validity of the stated problem within a certain theory and further its translation to computer programming. Furthermore, with a simulation model one can, with a tentative set of assumptions, verify the model-based theory (Schwaninger and Grösser, 2008). This is important, especially in cases of complex problems in which feedback loops, stochastic relations and nonlinearity are present, regardless of whether the process is a continuous or discrete event. Big picture presentations and 3-D animation of the simulated process make this technique flexible and transparent for testing a system’s performance in all phases of system design and deployment. With progress in ICT, visual interactive modelling (VIM) and animation, modelling and simulation (M&S) have become ever more central to the development of modern systems. This has made it possible to examine the projected performance of systems over wide excursions of design and environmental assumptions very early in the development process, when key resources are committed (Kljajić and Farr, 2008). The simulation model is used as an explanatory tool for a better understanding of the decision process and/or for defining and understanding the learning processes. The representation of the proposed approach is shown in Figure 3, adapted according (Kljajić, 1994). Figure 3 shows the interaction between the users, the simulation model and the vision-based scenario in the process of seeking a solution to a managerial problem or any other problem as decision support in a complex system. The following three basic loops are emphasised: a) The causal or the feed-back loop, representing the result as a consequence of former decision-making, and being a part of management experience and history of the system – feedback information, \( I_f \); b) The anticipative or intellectual feedback loop, which provides the anticipative information, \( I_a \), relevant to the formulation of the system strategy; and c) The \( a \ posteriori \) information model concerning applicability and former decision-making. This loop represents the pragmatic value of information, \( I_p \). The comparison of the prior information concerning the impact of the selected strategy on the system behaviour with the achieved results allows us to obtain knowledge, evaluate the value of the model and improve it. In other words, \( I_p=I_f-I_a \). Note that \( I_f>I_a \) is always fulfilled at the time of decision making. Loops a) and b) are the basic ones for knowledge
generation, experience for learning and quality decision-making. Loop c) represents knowledge validation. In literature, major attention has been paid to the methodology of design, testing and evaluation of the model. The user is, however, the key element of the three circles, because he/she is the one who makes decisions. As most simulation projects necessitate teamwork, considerable attention should also be paid to the presentation of findings in the decision-making process.

Figure 3. The principle diagram of simulation approach for decision support in enterprises

4.1. Learning model of decision making supported by simulator

In order to test the hypothesis concerning the impact of the simulation models on the decision-making process, a business simulator was developed (Škraba et al., 2003). The model consists of production, workforce and marketing segments. The subjects in the performed experiment had to find the proper values of simulator parameters, \( r_i \), in order to optimise criteria function. The role of the participants was to change the parameter values via the user interface, which incorporated sliders and input fields for adjusting the values. They could monitor the simulator response on the output graphs showing the four decision criteria (Capital Return
Ratio, Overall Effectiveness Ratio, Workforce Effectiveness Ratio, and Inventory Income Ratio) as dependent variables or any other state variables of the model. A total of 147 senior undergraduate management students were randomly assigned to work on three experimental conditions.

a) Determination of strategy on the basis of a subjective judgment of the task. A subject had to make an individual judgment about the best possible strategy on the basis of a presentation of the model by the Causal Loop Diagram (CLD) and the stated Criteria Function.

a) Individual determination of strategy supported by a simulation model. Besides all the facilities described in condition a0, each participant was working at his or her own workstation and could perform as many simulation runs as he or she wished in order to explore the behaviour of the model.

a) Individual determination of strategy supported by a simulation model and Group Information Feedback. Exploring the model by each individual was set the same as in condition a2. The subjects could access Group Information Feedback in the form of a table by clicking the Group Information Feedback button on the user interface.

The results of the decision process gathered when group feedback information was introduced revealed that the Criteria Function values of Group a3 were higher than in cases where the decision was based only on individual experience with a simulation model (Group a2), and the lowest Criteria Function values were achieved on the basis of subjective judgment (Group a1). These results were confirmed on a $p=0.01$ level of significance. In order to explain the influence of individual information feedback (assured by the simulation model) and group information feedback (introduced by GSS) on the efficacy of problem solving, we have developed a causal loop diagram (CLD) of learning during the decision-making process. The model shown in Figure 4 was modified according to (Lizeo, 2005, Kljajić Borštnar, 2006) and consists of three B and one R loops.

Loop B1 represents the decision-making process supported by just a formal CLD model (in Figure 4), and a paper and pen (Škraba et al., 2003; Škraba et al., 2007). The decision maker solves the problem by understanding the problem and the task. The higher the gap between the goal and performance, the more effort one should put into understanding of the problem.

Loop B2 represents decision-making supported by a simulation model and corresponds to experimental conditions a2 and a3 (groups supported by just individual feedback information of a simulation model). The higher the gap between the goal and performance is, the higher the frequency of simulation runs is. The search for the optimal parameter values is based upon trial and error. The more simulation runs that the decision maker performs, the more he or she learns (on an individual level), and the smaller the gap between performance and goal is
(in our case the optimised CF). We named this loop “Individual Learning Supported by Simulator”.

![Learning model of decision group under various decision-making conditions.](image)

Loop B3 represents direct contribution of group information feedback, while loop R suggests the reinforcing effects of group influence on problem solving at in groups $a_3$ (groups supported by individual feedback information of a simulation model and group information feedback provided by GSS). The decision maker of loop B3 understands the problem and the goal. He or she is supported by both simulator and group information feedback. While the use of the simulator supports individual learning, the introduced group information feedback enhances the group performance. Consequently the increased group performance reduces the need to experiment on the simulator. In other words, a decision maker supported by group information feedback has broader view of the problem, insight into new ideas and needs to put
less effort in problem solving. In contrast, the group information feedback stimulates group members to actively participate in problem solving, so that they perform more simulation runs in the process of searching for the solution (Kljajić Borštnar, 2006). When the group is satisfied with its performance, the frequency of simulation runs decreases.

Loop R can be further explained by interaction between group information feedback and facilitation of the decision-making process. As we observed in (Kljajić Borštnar, 2006), the group information feedback with facilitation contributes to higher feedback seeking behaviour and higher commitment to problem solving. Facilitation in this case serves as motivation and orientation towards the goal.

Participants’ opinions about participation in the experiment have been solicited by questionnaires. Participants filled in the questionnaires via a web application. Questions were posed in a form of a statement, and agreement to the statement was measured on a 7-point Likert type scale, in which 1 represents very weak agreement, 4 neutral opinion, and 7 perfect agreement with the statement. There were 10 basic questions about the experiment. The ANOVA test showed high agreement in opinion between groups.

From the opinion questionnaires we can gather some general observations:

1) 99% of the participants agreed on the general quality of the experiment,
2) 83% of all participants agreed that the decision problem was correctly presented,
3) 68% of all participants agreed that they understood the presented decision problem,
4) 93% of all participants agreed that the simulator was easy to use,
5) 84% of all participants agreed that the use of simulator contributed to understanding of the problem,
6) 70% of all participants agreed that there was enough time for decision making,
7) 63% of all participants agreed that they were motivated for solving the problem,
8) 88% of all participants agreed that they benefit from participating in the experiment,
9) 97% of all participants agreed that experiment was well organised,
10) 92% of all participants agreed that use of the simulator contributed to a better decision-making.

4.1.1. Anticipative value of information

The anticipative value of information obtained through the experiment could be estimated using Shanon-Harkevič information measure equation (6)

\[ I(a_i) = k \log(p(a_i)/p_o) \]  

(6)
where \( p_0 \) and \( p(a_i) \) represent the probability of achieving a goal without or with information, respectively, and a \( k \) constant. In practice, it is impossible to obtain a probable released goal in advance. This problem derives from the nature of the decision process. However, the simulation model of the process and anticipation of possible future impact from the environment can provide useful information to management.

![Anticipative Value of Information under different experimental conditions](image)

\[
0 < 1.4 < 2.5 < 3.1 \Rightarrow I_0 < I_1 < I_2 < I_3
\]

**Figure 5.** Anticipative value of information under different experimental conditions.

In our case, we suppose that the objective function (normalised) can take each value from the unit square interval with equal probability, if the experimental subject has no knowledge of the goal. The probability \( p_0 \) is then reciprocal to the unit square area of \( P0 = 1 \). In our case, this means maximal entropy of the experiment. With experimental conditions \( a_1 \), \( a_2 \) and \( a_3 \), we introduced information proportional to area reduction. By estimating the area \( P1=1/2, P2=1/4, \) and \( P3=1/16 \) and taking its reciprocal values, we obtained the probability of \( p(a_i) \). Using Equation (6), we can estimate the information content of the experimental condition. In the tested case, based on equation (6) where \( k = 1 \), the following is noted: \( l(a_1) = 4, l(a_2) = 2, l(a_3) = 1 \) bit and \( l(a_0) = 0 \). (Note that due to the normalisation of the area of CF and \( P0=1 \), reference is being made to the relative value of information obtained through experiments \( a_1, a_2 \) and \( a_3 \), where generality is not being affected).
5. CONCLUSIONS

The relevance of information systems is very important and their problems are very complex; therefore, a variety of research methodologies have been developed addressing this field. The variety of approaches is conditioned by the context of the problem and point of view of authors. In this chapter, we have discussed system dynamics methodology as appropriate for research in IS, more precisely in management IS. Our goal was to highlight the usefulness of SD methodology in research and implementation in management IS, particularly in decision support systems. SD was considered from general system theory and cybernetics perspectives. The advantage of SD as a part of System Approach is in the fact that a problem defined in natural language can be easily transformed into a directed graph convenient for qualitative and quantitative analysis in computer programs. In this case, the user can always check the validity of the stated problem and the model developed. SD enables studying the behaviour of complex dynamic systems as a feedback process of reinforcing and balancing loops. As a methodology, applying SD in analysing complex system behaviour is very important for several reasons: It is simple, because it is based on the natural laws of Rate and Storage that describe relations between elements in quantitative/qualitative relation; it is transparent, because it allows unique discussions about elements relations defining problem; it is coherent, because it consists of simulation tools harmonised with methodology and the problem to be solved. Human knowledge and the simulation methodology combined in decision support systems offer new levels of quality in decision making and research. In the near future, we expect that the methodologies of Simulation and the System Approach should be more intensively fused into one holistic methodology, the System Simulation methodology, and more intensively applied on social and ecological systems.

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SYSTEMIC INFORMATION LOGISTICS:
A DIRECTION FOR THE DEVELOPMENT OF
AN EMERGING FIELD OF STUDIES AND PRACTICE

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PROLOGUE
This essay addresses some of the challenges of information needs and information provisions, and proposes a systemic resolution to them. In this sense, the message presented here may well be regarded as an intellectual legacy of the research conducted by Professor Stig C. Holmberg for more than three decades. As a former student of Professor Holmberg, from the very beginning of my undergraduate studies, I was exposed to the notion that our understanding and use of information, its contexts and its various technologies, requires systemic thinking and acting in order to contribute to a human, social, and industrial wellbeing. I am deeply thankful to Professor Holmberg for the intellectual foundation provided to me and the message below manifests my gratitude.

1. INTRODUCTION

On Christmas Day 2009, a Nigerian man stepped on board Northwest Airlines Flight 253, bound from Amsterdam to Detroit. Shortly before the plane was due to land, he – a suspect with ties to al-Qaida – attempted to detonate an explosive device in his underwear; fortunately he failed. The CIA did pass some information about Flight 253 suspect Umar Farouk Abdul Mutallab to the federal interagency channel, but they appear not to have passed along all the relevant information that they may have had in their possession. The National Counterterrorism Center, which was created post-9/11 to connect the dots, failed to do just that and to ask the intelligence community for additional dots. The US President Barack Obama demanded answers as to why information was never pieced together by the U.S. intelligence community to trigger a warning and possibly prevent the botched Christmas Day attempt to blow up a Detroit-bound airliner – “There was a mix of
human and systemic failures that contributed to this potential catastrophic breach of security”, Obama said⁸. This call for a human and systemic solution of situations where the needed information is not provided in a timely manner to the right actor will be attempted in this essay; it is an attempt to outline some of the contours of Systemic Information Logistics.

This Introduction is followed by a section in which situations of information inadequacy are further elaborated on, concluding with the question: how to deal with them? The section that follows thereafter investigates in which way various professional and scholarly areas of information, and particularly the domain of Information Systems Development, are unable to secure that the right information is provided to the right actor at the right time. The subsequent section introduces the emerging field of practice and studies of accurate information provision, or Information Logistics, with its vision to provide the needed information in a timely manner and thus potentially manage information inadequacies. However, even though Information Logistics may advance our attempts to handle information inadequacies, it is in its current state unable to secure a positive handling of information inadequacies due to the inherent uncertainties of any pre-planned information provision. Therefore, the section after that proposes that Information Logistics needs Systemic thinking to address its inability to manage situations of information inadequacy. This initial conceptualization of Systemic Information Logistics may not assure us of fully secure information provision. However, it may offer a systematic reflection upon the actual limitations of information provision and thereby offer a warning for situations the consequences of which we would prefer to be without: like the blow up of a Detroit-bound airliner. In this sense, this essay suggests a direction for the further development of a field of practice and studies still in its infancy.

2. INFORMATION SOCIETY AND ITS INFORMATION INADEQUACIES

Imagine that you are due to fly tomorrow morning to a very important meeting one hour’s flight time from your home. The airplane is scheduled to depart at 8.00 am from the airport and you have set your alarm at 6.00 am for a wake-up call. Meanwhile, your computer system, which is connected to various systems including a meteorological information system, senses that there are very strong winds approaching your city and its airport, and that given historical information there is considerable risk that your flight will be cancelled. Therefore, your

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computer system orders a morning train seat for your travel and also wakes you up at 5.30 am instead, to make sure that you can catch the train at 7.05 am. Outcome: yes, you did arrive at your business meeting in time.

This is a colorful illustration of a situation, already present in our lives, which may be said to characterize Information Societies. Ever since Machlup’s (1962) seminal analysis and categorization of US production in reference to its GNP, our western societies have been characterized as Information Economies and Societies, and have thereby advanced from pre-agricultural through agricultural and industrial phases. The Information Age rests upon the notion that the creation, manipulation and integration, as well as the distribution and diffusion of information are all significant economic, cultural and political activities. There are various markers – technological, economic, occupational, psychological, and spatial and cultural – for making this characterization, for instance the kind of information products produced, the number of information workers, or the number of information production hours generated (e.g. Bell 1976; Porat, 1977). However, Information Societies are not limited to the business, industrial and professional sphere, as information activities are present virtually everywhere including in the public and private spheres (e.g. Castells 2000, 2009; Haftor & Mirijamdotter, 2010). And even though a fire of criticism has been generated towards the notion of the Information Society (e.g. Webster, 2002), this debate does not address whether information-centered activities and their outcomes do dominate our societies, but rather how much they dominate. While the proponents, such as Castells (2009), speak about a quantum leap, the critiques paint an evolutionary and balanced transformation – e.g.: “If there is just more information then it is hard to understand why anyone should suggest that we have before us something radically new.” (Webster 2002a: 259).

Independently of whether we do or do not wish to call the present age Information Societies, the statistics clearly show (OECD, 1981, 1986) the increased extent to which our human and social, business and industrial affairs are occupied with and dependent upon informational activities, technology, and their outcomes. Given this societal reliance on information, it is crucial to reflect upon situations, occurring over and over, where we experience numerous kinds and instances of information failures, arising when the right information is not provided in a timely manner to the actor needing it. The following dramatic examples are only five of many that illustrate information inadequacies and their potential tragic consequences.

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9 These examples are arbitrary for illustration purposes only; a comprehensive and systematic review of information failures is provided by M. Kajtazi (2011).
• January 28, 1986. USA. The flight of Space Shuttle Challenger ended with an explosion only 76 seconds into its space mission, causing the death of seven crew members and a loss of billions of dollars. This disaster was caused by a damaged O-ring, combined with a start on a very cold day, producing a leak in one of the two solid rocket boosters that ignited the main liquid fuel tank. NASA and Morton Thiokol, the two organizations that jointly launched Challenger, had information about this risk and its danger – yet this information was never shared outside of the organization or acted upon10, 11.

• December 29, 2003. A team of physicians, at the Sahlgrenska University Hospital in Sweden, received the results from a woman’s tissue test. It showed an aggressive tumor in one of her arms, which led the team to decide to amputate the woman’s arm. New post-surgery tissue tests showed that there was no aggressive tumor and that the team had received incorrect information – but it was too late for the woman’s arm12.

• December 26, 2004 manifested the second largest earthquake ever recorded on a seismograph. This 9.1 Richter scale undersea earthquake, with its epicenter in the west coast of Sumatra, activated a devastating Tsunami that hit the coasts of Indian Ocean around Indonesia and claimed more than 200,000 lives. The Pacific Tsunami Warning Centre in Hawaii, that detected the earthquake and anticipated the forthcoming Tsunami, provided warning information seventeen minutes prior the event to a variety of Indonesian authorities who failed to forward it to those who needed it most13.

• December 5, 2007. One of the largest Swedish foods retailing companies, with more than 1,400 stores in Sweden, was involved in a scandal that resulted in food safety problems. At least four of its stores re-packed out-of-date meat and provided incorrect information about the product to its consumers, which could have resulted in deadly viruses14.

• December 11, 2008 manifested the largest ever committed investor fraud, which highlights the well-known dilemma of information asymmetry in market transactions (Akerlof, 1970). Fraudulent information was purposefully provided to the investors, who were unaware of the almost two decades long fraud allegedly committed, including fabricated gains of

References:
10 see: http://space.about.com/cs/challenger/a/challenger.htm (January, 2011)
11 see: http://history.nasa.gov/rogersrep/genindex.htm (January, 2011)
12 see: http://www.dn.se/nyheter/sverige/amputerade-arm-i-onodan (February, 2011)
14 see: http://www.thelocal.se/9319/20071206/ (March, 2011)
$65$ billion; all hidden and mysteriously manipulated by Bernard Madoff until the collapse of the Ponzi scheme\(^{15}\).

This list of real life situations, where needed information was lacking and thus gave rise to unwanted consequences, could be much longer as shown by Kajtazi (2011), and proposes that such situations have an underlying generic pattern, and call these instances *Information Inadequacy* (ibid). This is understood to mean situations where the right information is lacking at the right time at the needing actor’s end, either because it was never delivered or it was delivered yet another information overload hindered its absorption. The above-listed disaster with the Space Shuttle Challenger illustrates a situation where relevant information was available within the organization yet not to the decision-makers in charge who could have stopped the launch of Challenger and thus saved the lives of seven crew members. The case of the tragic faulty amputation of a woman’s arm illustrates how malfunctioning procedures provided the wrong information and thereby resulted in an irreversible medical act. The tragic 2004 Tsunami described above illustrates a situation where needed information was generated on time (in Hawaii), and transferred to relevant governmental bodies (in South East Asia), but that these organizations lacked the capability – i.e. procedures and resources – to distribute warning information to the people needing it.

Situations where the right information is not delivered on time to the actor needing it may be produced by various causes (Kajtazi, 2011). Examples of this include when the needed information was never required, yet it may have existed somewhere. Another cause is when the needed information was never generated, for the same reason. It may also be that the needed information was not delivered due to technical failures, or economic priorities. Yet another cause is a situation where the needed information was not delivered due to political structures of coercion that prevented such a delivery even in cases when information was explicitly required. On the other hand, a situation where the needed information was delivered to its needing actor, who was unable to absorb it, may be caused by information overload, information misinterpretation by the receiving actor, or information illiteracy caused by the intended information receiver’s inability to select or interpret the needed information. The need to deal positively with information quality challenges is called for continuously both by academic quarters (e.g. Edmunds & Morris, 2000; Himma, 2007; Bawden & Robinson 2009) and by practitioners (e.g. Hemp, 2009; Dean & Webb, 2011). These and other challenges give rise to the following question: *How to assure that the right information*

is provided at the right time to the right actor? This leads us to the next two sections that will review some attempts to answer this question.

3. LIMITATIONS OF INFORMATION DISCIPLINES AND PROFESSIONS

A number of professional domains and academic disciplines directly or indirectly address the question of how to assure that the right information is provided to the right actor at the right time.

One well-established domain is the Library profession and the corresponding Library Studies (e.g. Aggarwal, 2005; Bates, 2009). Its main focus is on how to classify and organize large volumes of diverse and semi-coherent information so that its retrieval and access may be as precise as possible. This interest and capability is undeniably crucial for the wellbeing of Information Societies in general and as a contribution for dealing with Information Inadequacies in particular, as it is easy to imagine that well organized information entities may facilitate successful information provision. However, Library practices and studies do not answer the question being asked here since, for example, information may be well classified and organized, yet this alone will not assure that the needed information will be provided in time to the needing actor.

A closely related domain, which is sometimes regarded as an independent one and sometimes as a part of the Library profession and studies, is the study and practice of Information Literacy (e.g. Doyle, 1994; Walter & Shinew, 2004). This may be understood as human actors’, or citizens’, capability to acquire the needed information (Walter & Shinew, 2004). More specifically, The American Library Association suggests that “To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.”16. This is an important contribution, as it clearly focuses the information needing agents, and its capability to recognize its information-needs and how to satisfy them; this is in clear contrast to the too prevalent focus on information itself or its technologies (Walter & Shinew, 2004). Yet, there are inherent limitations in this approach. Firstly, there is not much theory provided other than the mentioned ambition (Ibid.). More importantly, even if we could secure that a human actor possess the capabilities needed to recognize information needs and then how to search for the needed information, there may be contextual conditions that are limiting. These include the fact that information is not always produced or that information is actively hindered. In this sense, it is not enough to

16 See: http://www.ala.org/ala/mgrps/divs/acrl/publications/whitepapers/presidential.cfm
(April, 2011)
focus upon the information needing actors, there also is a need to comprehend the information as such, its transfer, its source and the latter’s information generations (Kajtazi & Haftor, 2011).

Another well-established domain relevant for the present inquiry is the Communication profession and its corresponding Communication Studies (e.g. Corner & Hawthorn, 1989; Fiske, 2010; Vivian, 2011). In contrast to the Library practices and studies, Communication focuses mainly on the prior activities needed to elaborate an intended meaning of the transferred information at the receiving human agent and also the post-communicative activities that analyze the actually emerged meaning arising from an information transfer (Fiske, 2010; Eriksson, 2007). Also this interest and capability is crucial for the well-being of Information Societies; this is so as an intended meaning needs to be generated at the receiving end in order to contribute to the elimination of information inadequacies. However, Communication practice and studies do not answer the question posed here, since a successful establishment of the intended meaning does not assure that this was established in time and for the right actor.

Another domain of relevance which is mainly an academic endeavor is that of Information Theory (Goldman, 1953; Ash, 1965; Cover & Thomas, 1991) and Information Studies (Adkisson, 1976; Emard, 1976; Floridi, 2010). This focuses largely on the question of what is information. As shown by a recent inquiry into this topic (Kajtazi & Haftor, 2011 ), there is a set of notions as to what information is, ranging from more philosophically oriented notions, through behavioral to notions based on natural sciences. Yet, we lack an accepted common notion of what information really is (ibid.). Information Theory and Information Studies can not help us to successfully address the question of this inquiry for at least two reasons. Firstly, even if we have a well-elaborated and accepted notion of what information is, we will not be able to assure that the right information is provided on time to the right actor. Secondly, there is no common notion\(^\text{17}\) of what information really is; therefore it is not possible to derive a stable solution for information inadequacies from these domains.

It is now time to turn our attention to the Information Systems practice and its academic Discipline (Hirschheim, Klein, Lyytinen, 1995; Checkland & Howell, 1997; Galliers, Markus, Newell, 2006; Beynon-Davies, 2009). Information Systems (IS) is probably the domain that has put most effort, both its practices and its studies, into generating an answer to the question being put here. IS as a practice

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\(^{17}\) Even though the notion of what information is lies outside the explicit scope of this inquiry, there is an implicit working assumption here. This is based upon the seminal elaboration of information by G. Bateson (1972) who proposed that information is a difference that makes a difference.
may be regarded as encompassing the planning, development, diffusion and implementation of an IS within and across organizations and its individuals; it also includes the consequent operations, maintenance and management of IS and its technical infrastructure, and finally the eventual abortion of an IS (Beynon-Davies, 2009). From an academic viewpoint, the IS Discipline studies Information Systems Development, Information Systems Operations and Maintenance, and Information Systems Effects – all at an individual actor’s level, at organizational and inter-organizational level, and at the level above organizations, such as in regions, countries or even societies and above (e.g. Cecez-Kecmanovic, 2005: 21; Galliers, Markus, Newell, 2006). In this context it is particularly relevant to focus on the Information Systems Development (ISD) phase of IS practices and studies. This is so as it is these activities that is responsible for the very conception of what a particular IS should be, in terms of the information it should provide, to whom and when, in what format and at what cost (Hirschheim, Klein, Lyttinen, 1995). It is thus ISD practice and studies that have the potential of answering the question posed here: How to assure that the right information is provided in time to the needing actor?

3.1. Limitations of Information Systems Development

Before the initiation of an interrogation into the ISD studies and practice, the notion of an Information System as such needs to be explicated. To this end, there are numerous understandings of the generic concept of an IS, with considerable overlap in their meaning (e.g. Alter, 2006, 2008). The United Kingdom Academy for Information Systems holds that an Information System is the means by which organizations and people, utilizing information technologies, gather, process, store, use and dissimilate information (UKAIS 18). Alter’s (2008) recognized notion suggest that an “IS is a work system whose processes and activities are devoted to processing information, that is, capturing, transmitting, storing, retrieving, manipulating, and displaying information.” (ibid.: 451) and further, “an IS is a system in which human participants and / or machines perform work (processes and activities) using information, technology, and other resources to produce informational products and / or services for internal or external customers”. (ibid.: 451). While the two definitions are probably representative for both IS practice and studies, the first definition given represents the standard practices of IS professionals and academics where an IS is bound to some underlying electronic Information and Communication Technologies (ICT), whether implicitly or explicitly (e.g. Cecez-Kecmanovic, 2005: 21; Galliers, Markus, Newell, 2006). On the other hand, the merit of the second definition given is that it accepts that an IS may be realized without any underlying ICT; unfortunately this

18 See: http://www.ukais.org.uk/about/DefinitionIS.aspx (March, 2011)
work-system based notion may not be regarded as representative of either the IS profession or the IS discipline, something that will be further addressed here. It is now time to initiate an interrogation of the ISD thinking and practices.

3.1.1. Information Systems do not need to be bound to Information and Communication Technologies

As highlighted above, the practices and studies of IS:es are based upon the assumption that an IS needs to be realized by means of the underlying electronic Information and Communication Technologies (e.g. Ceez-Kecmanovic, 2005: 21; Galliers, Markus, Newell, 2006) which execute the various information processing functionalities, such as manipulating, storing, retrieving and communicating. While such technologies are surely powerful means for many kinds of information processing, this does not mean that an IS should be reduced to this (as also argued by Alter (2008)). One reason is that some kinds of information cannot easily be processed by electronic technologies, for example, it is hard to read a book about how to swim and assume that one will have received a fully comprehensive description of it; rather there also is a need to practice swimming which generates experiences and thus the information needed for a successful learning process of how to swim. Another reason is that there are contexts and situations where these electronic technologies may not be employed easily, for example for economic, political or other reasons, as manifested in the 2004 Tsunami disaster described above: many of the victims could neither effort ICT:s nor were they literate in how to use them successfully.

There is therefore a need to extend the current limitation of IS practices and studies to also include IS:es that are not realized by means of electronic ICT. This in turn may open up opportunities for the provision of information which can be difficult or impossible to process electronically and also to deal positively with information needs in contexts where ICT:s may not be deployed, for whatever reason.

3.1.2. Limitations of Current Information Systems Requirements Practices

A standard Information Systems Development process may be understood in terms of its key working phases or kinds of activities. One basic way of specifying these developmental phases may be in terms of the requirement specification, the construction, the implementation, the maintenance and operation, and the abortion of an IS (e.g. Beynon-Davies, 2009). The requirements specification work is crucial as its aim is to define what kind of information is to be provided, to whom, in what format, when and in which context, for example. This is clearly a key task for any
IS development; if the requirements specification is not successful the final IS will most likely fail however well the other ISD activities are conducted.

One standard practice for the identification of information needs is to ask the future users of the planned IS what kind of information they need, in what format, in what context, etc., (e.g. Beynon-Davies, 2009). While such an approach may surely generate a definition of information needs to serve as a foundation for forthcoming IS conception and subsequent construction, there are several crucial limitations inherent within this ask-what-do-they-need approach.

One limitation is that this approach builds on the assumption that the intended IS users are known before the IS construction. And also, if the intended users are known and their number is large, the assumption is that a small subset of this large group will be representative for the whole group’s information-needs. A second and related limitation is that even though the intended users are known, which is often yet not always the case, the assumption is that the future IS users do know what they want! And then a third closely related limitation is the assumption that the intended IS users are able to express and communicate their needs to the IS requirements engineers. Next, even if these three assumptions were fulfilled positively in a specific case, i.e. that the intended IS users are known, that they know their information-needs, and are capable of expressing and communicating their information-needs, then there is the challenge of the validity of the information-needs expressed – i.e. how to validate something that has yet to be realized? (e.g. Eriksson, 2003) The employed IS development practice is to ask other intended IS users, and then fall back on the same assumptions and their inherent limitations.

Clearly, all these assumptions lack empirical validity. There are situations where all the listed assumptions may be fulfilled, yet there are too many situations where such a fulfillment is not the truth (e.g. Fitzgerald, Russo, Stolterman, 2002). And there is yet another limitation to the ask-what-do-they-need approach, namely the temporal dynamics of information-needs. That is, even though all the above mentioned assumptions may have been fulfilled successfully, there is a need to translate the defined IS requirements into IS software and hardware and its deployment, which in turn requires time. The information-needs are frequently dependent upon their context which in turn may change (ibid.). This means that when a new IS is developed and provided to its users, the same users who were asked to provide their information-needs may now have altered their needs, in the sense of: ‘We have restructured our organization and need to have information about this new structure for the more than one hundred thousands employees’.

Alternatives to the information-needs asking approach have been conceived. Two related techniques are the so-called use-case modeling (e.g. Jacobson et al. 1992; Bittner & Spence, 2003) and process modeling (e.g. Michael, 2005) techniques.
The core idea of these two techniques is that instead of asking the intended IS users for their information-needs, one should attempt to identify the to-be situations of the intended IS. In this, a use case is a description of a potential series of interactions between an IS and an external agent, which lead the agent towards something useful. The identified interactions are then broken down in terms of the information exchanges between an IS and the interacting agents, thereby manifesting information-needs for the IS to be developed. Similarly, the process approach implies that a relevant organizational or inter-organizational process will be identified and described in terms of its constituting activities and information-needs, where the latter may serve as a specification for the IS requirements. While the use-case modeling and process modeling techniques have advanced the ability to identify information-needs for an intended IS, ultimately they all rest upon similar assumptions as listed above – e.g. who is to define the use-cases or the processes, and how do we know that the right use-cases or processes have been communicated correctly?

Yet another more recent alternative to the traditional ask-what-do-they-need approach for information-need identification is the so-called Living Labs approach (e.g. Følstad, 2008; Schumacher & Niitamo, 2008; Bergvall-Kåreborn & Ståhlbröst, 2009). This may be regarded as a user-centered eco-system involving both research and innovation processes. A Living Lab provides an environment for exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and systems in real-life situations. Unlike the ask-what-do-they-need approach discussed above and its derivate use-case and process modeling techniques, the Living Lab does not rely upon the ability of an intended IS-user to introspectively identify the correct information-needs, and then to express and communicate them adequately. Rather, the Living Lab approach relies on the user’s ability to show information-needs by actually using an IS (Bergvall-Kåreborn & Ståhlbröst, 2009). This approach relies heavily on the engineers’ ability to conceive and then provide an actual IS, with its information and functionality. It also relies upon the users’ ability to use it and explore it. Even though the Living Lab approach handles positively several of the limitations within the ask-what-do-they-need approach, and its mentioned derivates, again it has its own limitations. One is that it rests upon the assumptions that the developer will be able to a priori conceive and offer an IS to the users that to some extent anticipates their needs, and that the provided IS may be altered to meet the unrealized information-needs. Further assumptions are that the users are literate enough to navigate the IS and also that the social, economic, and political context opens for an involvement of the intended IS users; all these assumption lack empirical validity (e.g. Fitzgerald, Russo, Stolterman, 2002).
Finally, yet still another recent approach to facilitate the requirements definition of an IS is the design pattern approach (Adolph & Bramble, 2002). Its core idea is that a previous successful requirement specification of a particular IS may be reused for the specification of a subsequent IS. While this approach is useful in some instances, particularly for the so-called hygiene functionalities (e.g., printing), its assumption is that the historical experience is determinative to the future, which in turn assumes that there is no need for innovation and that all current needs have already been identified by historical events. A second assumption here is that the ISD process will be able to identify the right match between the various historical patterns and a specific information-need situation at hand. Clearly, all these assumptions may be met in some cases, yet may not be met in other situations, justifying this inquiry.

The above interrogation suggests that the conventional and also the more modern approaches to the IS development have inherent limitations that hinder ISes from securing that the right information is provided in a timely manner to the needing actor. This brings us to the next section where the emerging field of Information Logistics is surveyed with the hypothesis that it may surpass some of the limitations inherent in Information Systems Development and also the other domains and disciplines reviewed in brief above.

4. THE EMERGING FIELD OF INFORMATION LOGISTICS

This section provides a brief review of Information Logistics as an emerging professional and academic domain. The key message from this review is twofold. Firstly, Information Logistics offers a perspective and an ambition that serves as a complement to the Information Systems studies and practice, and that attempts to remedy its limitation: the inability to secure that the right information is provided in time to the right actor. Secondly, Information Logistics currently does not, and prospectively never will, completely resolve this challenge, which is the key reason for its need of a Systemic meta-theoretical foundation that is the subject of the following section and the key message of this essay.

4.1. This is Information Logistics

A recent and detailed review of Information Logistics research and practice (Haftor & Kajtazi, 2010) identified twelve distinct approaches to Information Logistics. While this is not the place to replicate that detailed review, five key approaches will be briefly presented here with the focus on how Information Logistics succeeds or fails in its aspiration to help to provide the needed information to the
right actor, on time. The five approaches are selected so as to present the most significant contributions of Information Logistics.

The earliest academic publication, to our knowledge, that addresses the domain of Information Logistics, came from Harvard University in the USA in 1978 (Wormley, 1978). Its main merit is probably to have put new questions on the agenda rather than to have provided any definitive answers. This initiative proposed that “…information logistics will, for our discussion, refer to the management of all activities which facilitate information (as a product) movement in order to supply customers with the place and time utility in information goods and services they demand.” (Wormley, 1978: 4). The focus here is on information transfer and on information provision in a timely manner in the right place, implying that an actor is put in focus with the utility that information may give rise to when provided adequately. This arose from the context where attention was drawn to the fact that a significant portion of organizations were concerned with the production and supply of information products (e.g. newspapers) rather than physical goods (e.g. hammers). While no new theoretical contributions are provided here, the formulated questions still show relevance, hence: what are the crucial problems associated with local distribution of information?; what are the costs associated with local distribution of information?; what are the trade-offs among various modes of information delivery?; and, what are the regulative and legal issues to be considered? (ibid.) For example, this last question shows its relevance particularly in the year 2010, when the European Union decided to de-regulate the postal services within its member countries19. There was also a methodological suggestion that will be further explored below. The researchers suggested that Systemic thinking, and more specifically General Systems Theory (von Bertalanffy, 1968), should be considered as a meta-theoretical foundation for the development of Information Logistics, in order to secure a proper inter-disciplinary research approach (Wormley, 1978).

The second approach to be presented here comes from the University of Amsterdam in the Netherlands (Gerrits, Sijbrands, 1992; Gerrits, 1995), and has a similar motivation: how to understand and also how to manage operations that are primarily concerned with the production of information rather than physical goods – i.e. banks, insurances, movies, or medical and legal advisory services. The focus here is on the identification of some of the generic principles inherent in any operations occupied with the production and transportation of information; one of the outcomes here is an account of the information-production time-elements. Again, this focus draws our attention to the temporal delivery of information that

is conceptually independent of any processing technology (Gerrits, 1995). The limitations of this initiative include its research design: conventional logistics theories, which account for physical goods transportation, constitute the foundation theory for this contribution, exercising a reduction of information to a physical entity (Haftor & Kajtazi, 2010). While the main merit here also is to have put the question of a timely information provision on the agenda.

The third approach to be accounted for here comes from Frankfurt University in Germany (Fricke, 2007; Grolik, 2007) and focuses upon the optimization of information flows within industrial networks, such as between a car-maker and its various suppliers (Grolik, 2007). The key motive is the various operational disruptions in companies caused by the lack of needed inputs that in turn are the result of the lack of timely needed information (e.g. a change request for production). Information Logistics is thus here understood to be a network of nodes linked with channels for information transfer between these nodes (i.e. firms), including transfer standards or protocols, and then information flow patterns that emerge in such a network depending on how the information flow is directed (Fricke, 2007). Two theoretical models are advanced for an optimal information flow in such networks. The first assumes that all network nodes, i.e. various companies in the automotive supply chain network, are homogenous, and the common goal is to find the optimal cost of information flow between these nodes (Grolik, 2007). This constitutes an economic model of information-flow that covers inherent tasks; e.g. selection of communication paths, channels, and nodes. The second model assumes that the network nodes are heterogeneous, i.e. autonomous, self-interested, and utility maximizing (Fricke, 2007). The goal here is then to find the optimal coordination of information-flow allocation. It is recognized here that it is not possible to find an optimal coordination of information-flow allocation that is centralized for the whole information network, e.g. supply chain. Therefore the research strategy assumed utilizes decentralized algorithms. The result generated is an information allocation algorithm based on an update mechanism that maintains a weak consistency of replicated information in the network (Fricke, 2007). This allows increased efficiency with maintained quality of information-flow for decentralized and distributed computing, based on local information. Theoretically regarded this is probably the most successful research program within Information Logistics; however, its results have not been able to find practical implementation. This approach focuses extensively on the optimal transfer of information flow, with the assumption that it will generate a timely delivery of the needed information. As the very content, or semantics, of information is ignored here in favor for its form or syntax, this approach can only state that information will be delivered in time, it thus fails to secure that the right information is delivered (Haftor & Kajtazi, 2010).
The forth approach to Information Logistics accounted for here comes from the University of St. Gallen, in Switzerland (Bucher & Dinter, 2008; Lahrmann & Stroh, 2009; Dinter & Winter, 2009), and regards Information Logistics as following: “Information logistics (IL) comprises the planning, control, and implementation of the entirety of cross-unit data flows as well as the storage and provisioning of such data. In order to differentiate IL and operational data integration, only those data flows are considered to be IL components which support decision making. If data is used for decision making in the same organizational unit where it originates, such flows do not fall under our IL definition because in this case, most of the managerial challenges do not occur.” (Dinter & Winter, 2009) The overall empirical need addressed here is how to realize synergies in an organization, when different actors and functions collaborate, by means of information exchange and provision between these actors and functions. One research result provided is a survey that categorizes organizations with regard to their Information Logistics practices, where the categories identified are: Information Logistics that is centralized and integrated into organizational processes, Information Logistics that focuses on data system quality, Information Logistics that employs standardized technology applications, and a mix of these categories (Bucher & Dinter, 2008). This research program also focuses on the transfer of information with a particular emphasis on needed information to be provided to a needing organizational unit, and implicitly an agent. Its key focus is also its limitation, as the focus only on cross-functional information transfer is highly arbitrary and unjustified. A second key limitation here is its underlying assumption that by means of delivering the right information to the right organizational unit an optimal organizational behavior will be reached. Organizational studies have shown long ago that such an assumption lacks empirical validity as there are other organizational forces that contribute and hinder to such an end (e.g. Morgan, 1986).

The fifth and final strand of Information Logistics research to be presented here has its centre at the Technical University of Berlin in Germany and the Fraunhofer Institute for Software and Systems Engineering, with links to other countries such as Sweden, Poland, Russia, and China (Smirnov et al. 2003; Sandkuhl et al. 2004; Lundqvist et al. 2008; Sandkuhl, 2008). In contrast to the above-presented Information Logistics research approaches, which typically operate in Social and Economic Sciences Faculties, this approach represents a technology-oriented direction, with a highly applied emphasis (Deiters & Heuwinkel, 2002; Heuwinkel et al. 2003). Generically speaking, there are two key research fronts. One is the coordination of information transfer, from a source to its destination (e.g. Smirnov et al. 2003). The second is the provision of information that is needed by an actor, whether human or machine (e.g. Sandkuhl, 2008). This research program as a whole may be understood in terms of user-demand information supply and is
manifested in various software artifacts to deal with the two empirical challenges for organizations and their individuals. In the first case, this is multi-agent software that retrieves and matches information needs with the available information (e.g. Smirnov et al. 2003). In the second case software and various modeling tools are conceived to automatically detect an actor’s needed information and to filter-in and provide the right information (Sandkuhl, 2008; Meissen et al. 2004; Lundqvist et al 2005). Three key advances of the latter include technology for so-called role-based information provision, followed by situation-based information provision, and finally context-based information provision (Haseloff, 2004; Meissen et al. 2004; Lundqvist et al. 2005). This is by far the most successful Information Logistics research program in terms of the volume of publications and in terms of the research results implemented in real-life contexts. The applications provided within this Information Logistics approach have shown that it is possible to construct artifacts that serve humans with the right information at the right time. One particular illustration of this is the weather warning system developed and deployed for non-professional boating and provided by insurance companies to their customers; it has saved lives, trouble and costs to the involved stakeholders (Deiters, Heuwinkel, 2002; Heuwinkel et al., 2003). The central limitations inherent within this research frontier include its reliance on information processing technology, its focus on the syntactical aspect of information and exclusion of its semantics, and its focus on the information receiver and its needs together with the process of information transfer while ignoring the information generation and sourcing (Haftor & Kajtazi, 2010).

To the above presented five strands of Information Logistics, we will now add a very recent contribution (Kajtazi, 2011) that attempts to identify the invariance, or patterns, of what hinders the provision of the right information in a timely manner. While this research is still in its very initial phase of exploration it suggests that a variety of factors produce such hindrances, ranging from political power coercion, through cultural heterogeneity, to inefficient processes and their failing information processing technologies (ibid.).

In summary, this exposé of the key research strands of the novel domain of Information Logistics shows a clear attention to a timely provision of needed information to the right actor. The ambition of Information Logistics, and also its preliminary and modest theoretical and practical contributions, constitutes a significant advancement in relation to the above-outlined limitations of Information Systems practices and studies. This is the case as Information Logistics does not rely on the false assumption that by asking the actor needing information what the needed information is – whether explicitly or implicitly through prototyping – we may obtain the right answer. Information Logistics assumes that there is a need to actively support the very process of definition of what is right
and timely information, and to do this in a continuous manner. Principally, this is attempted in two ways: by addressing the adequacy of information transfer from its source to its receiver and by addressing the definition of the receiver’s information needs.

**4.2. Key Limitations of Information Logistics**

Even though Information Logistics represents a positive contribution and advancement to the practice and the study of information management in general and information provision in particular, it also rests on certain assumptions that prevent it from providing a definitive resolution to the question of how to secure that the right information may be delivered at the right time to the right actor.

Its innovative approach of devising information technology which operates models that actively and in a timely manner filter the needed information (e.g. Sandkuhl, 2008) is successful in many instances, yet not all; there are several limitations. One is that this approach rests on the assumption that the information needing actor always has access to information processing devices. While this is often the case in the developed world, it lacks empirical validity in the developing world. Technology-bound information filters could have saved the lives of tourists from Western countries visiting Thailand during the 2004 Tsunami in the South-East Asia but would make no difference for the poor Thai people in the countryside as they cannot influence its ownership or its use, and also often lack the skills for how to use it. Another chief limitation of this information filtering approach is inherent in both the information matching and information filtering models operated by such technology. Information matching is based upon the so-called semantic machining algorithms (e.g. Dou, McDermott, Qi, 2005) which rest on a pre-given assumption of how two or more syntactical expressions may relate to each other. Such assumptions are bound to fail and they can not account for all the variants of a term’s use in natural languages (ibid.). Further, as the information filtering models focus on the information needing actor’s roles, contexts or situations (Sandkuhl et al. 2004; Sandkuhl, 2008) these also require a predefinition of what a role (or a situation or a context) is, and what the correspondingly relevant information needs are. Clearly, such pre-definitions are based upon previous experiences and on assumptions about the future which are all selective in relation to what actual future may or may not emerge. And this is probably the chief challenge of Information Logistics in particular and of Information Management in general: *the impossibility of always predicting the future and its information needs.*

Informational Logistics’ solution to the optimization of information transport is also an important and positive contribution to Information Management and information provision. However, as is the case with information matching and
filtering, the information transfer models and technology also focus entirely on the syntactical side of information and build on the assumption that historical and pre-defined events of optimal information transfer will be valid for future events and its actors’ information needs. Neither historical nor mechanical determinism have been able to outline future events in human, social nor industrial affairs!

In summary, Information Logistics constitutes a significant conceptual and practical advancement to the challenge of providing the needed information at the right time to the right actor. It addresses positively some of the invalid assumptions upon which Information Systems practices and studies rest and may thus be regarded as a complement. However, Information Logistics rests upon its own assumptions, which seem to partly lack empirical validity. One of its key assumptions is that we may a priori define methods and models that can sense information needs and then find and filter in and out, in a timely manner, the needed information to its actor. This assumes that human rationality may conceive and assemble rational models and procedures that generate a perfectly comprehensible understanding of all future information needs. The second and consequent assumption is that if such rational models for perfectly comprehensible information provision could be conceived then there will be ethical, political, economic, social and technological space to realize their actual utilization. Clearly, we can never satisfy completely these two assumptions as the human reason has its inherent limitations and the space for implementation is often challenged. Does this mean that we should give up the ambition of Information Logistics: to provide on time the right information to the needing actor? The next section proposes that an imperfect yet positive remedy to this challenge does exist: a Systemic contribution.

5. SYSTEMIC CONTRIBUTION TO INFORMATION LOGISTICS

The review above postulates that the ambition of providing the right information at the right time to the needing actor cannot be satisfied by current disciplines and practices of the domains of Information, Library, Communication, and Information Systems. A more recent domain of practices and studies, Information Logistics, has this ambition as its main purpose. While Information Logistics does contribute significantly to the satisfaction of this ambition in relation to the other domains mentioned, it still has its inherent limitations. One key challenge identified above is the unjustified assumption that human rationality may a priori and successfully comprehensively anticipate the future temporal information needs for specific actors.
To this end we wish to recall the seminal contributions of two distinguished social and management scientists: Herbert A. Simon and C. West Churchman – both have been nominated for the Nobel Prize, Simon being awarded it in 1978. Simon and Churchman were both Americans but represented rather different intellectual traditions. Simon had a clear rationalistic and positivist foundation and outlook, having been educated at the University of Chicago where one of his philosophy teachers was R. Carnap from the Vienna Circle. Simon graduated in organizational sciences and made key contributions to cognitive sciences, computer sciences, economics and management sciences. Churchman was a philosophy graduate from the University of Pennsylvania, where his principal teacher was Edgar A. Singer, who was in turn a student of William James, the American psychologist and philosopher. Churchman made important contributions to logics, theory of measurement, was a cofounder of Operations Research and Management Sciences and thereafter of the so-called Systems Approach. Coming from rather different intellectual traditions, Simon’s and Churchman’s theoretical contributions differ significantly with regard to basic assumptions held, content formulated and form employed. Yet, both send a similar message relevant for the present inquiry. Simon’s Theory of Bounded Rationality (Simon, 1957, 1990, 1991; Gigerenzer & Reinhard, 2002), in brief, states that human rationality is limited with regard to its capacity of producing rational decisions, including its limitations to access and process relevant information; this is of dual significance for the present inquiry, on the one hand is its inability to produce models that are capable of providing adequate information to the needing actor, and on the other the needing actor’s limitations in accessing and processing needed information available. Simon suggests that human decision-making processes seek satisfactory solutions rather than optimal ones (e.g. Simon, 1957). Churchman, on the other hand, has challenged the notion of human rationality in several of his works – Systems Approach (Churchman, 1968b), Systems Approach and its Enemies (Churchman, 1979), The Design of Inquiring Systems (Churchman, 1971), and Challenge to Reason (Churchman, 1968a) and Thought and Wisdom (Churchman, 1982) – stating that it is impossible for any human being to reach an all-comprehensive understanding of the world in which he or she lives: past, present, and future. Yet such a comprehensive understanding is necessary to derive an optimal solution to any non-trivial problem.

Given that both Simon and Churchman conclude that a fully satisfactory solution to the challenge of providing the right information, in time, to the needing actor is not possible, because of the designer’s inability to conceive such a solution,

21 See: http://en.wikipedia.org/wiki/C_West_Chiphman
does that mean that we are to give up this ambition? Simon and Churchman also both provide us with tentative avenues to help us address this challenge; and both – independently of each other – turn to Systemic thinking in this regard.22 Simon offers his hierarchical theory of complexity and its decomposition (Simon, 1962) while Churchman offers theoretical components for the process of unfolding (Churchman, 1968b, 1979) and of key stakeholder. Time has shown that while Simon’s solution was innovative and attractive, its potential is limited. On the other hand, Churchman’s proposals have been adopted and adapted and are operationalized in at least two schools of Systems thought. One is Soft Systems Thinking, as championed by P. Checkland (Checkland, 1981; Checkland & Scholes, 1981), with its explicit cultural awareness in the problem formulation phase of any human endeavor and the fact that it turns away from the ambition of optimization in favor of learning (Checkland & Scholes, 1981). The second is the Critical Systems Thinking approach, as championed by W. Ulrich (Ulrich, 1983, 1987) in the form of his Critical Systems Heuristics (ibid.). This work starts with Churchman’s massage of the human planning dilemma: On the one hand, epistemologically regarded human rationality may never guarantee a fully comprehensive understanding of any non-trivial situation, implying that any human decision-making is unconditionally selective with reference to the knowledge and the values employed – this includes the conception of what information is needed for a given actor. On the other hand, there is the moral imperative that consequences to other human fellows of human decisions, should be such that any harmful consequences of these decisions are minimized or eliminated. Yet, the identification of such harmful identification is not possible in non-trivial situations. However, Ulrich has developed a sophisticated method that systematically guides self-critical reflection upon the very limitations inherent in a given decision-making process. And this constitutes the key proposal of the present inquiry. More specifically, Ulrich’s approach does not offer any way to secure that a rational model is conceived and that it guarantees the provision of the right information to the right actor in a timely manner. Critical Systems Heuristics rather offers a means for systematical and critical reflection upon the unconditional inherent limitations of any humanly conceived systems – here, for any Information Logistics system and particularly its inability to provide timely and correct information to the needing actor. Even though such systematic self-critical reflections are bound to error, this approach shows a significant and important advancement in relation to the current

22 Simon’s and Churchman’s notions of decision-making and rationality were confronted in a fictive debate (Ulrich 1980); however, its details are outside the scope of the present inquiry.
Information Logistics state; also there seems to be no other better solution than the dogma that a fully comprehensive solution may be conceived by the human mind.

Systemic Information Logistics, incorporating both the ambitions and the capabilities of the current Information Logistics together with the Critical Systems Heuristics approach, is potentially able to inform us about the limitations in our conceived and realized designs of information provisions solutions. To illustrate such Systemic Information Logistics, imagine the following situation. In the recent 2011 Tsunami that devastated the North East coast of Japan and killed thousands of people, the Head of a certain Hospital in a certain city received information that a Tsunami-wave would hit the hospital within 30 minutes. The standard procedure was to attempt a transportation of at least some of the employees and patients to another place uphill. The head of the hospital knew that the information was not fully reliable with reference to the time for the wave’s arrival and decided to move all people present in the hospital to the roof of the hospital. The wave arrived 20 minutes after the warning was received and would have hit people if they had been transported from the hospital. The critical awareness of the limitations of the information provided saved lives.

6. SUMMARY AND CONCLUSIONS

The argument pursued in this essay starts with those too frequent empirical situations where the lack of needed information, for whatever reasons, has had unwanted consequences, for example bankruptcies of large corporations, human fatalities from earthquakes and tsunamis, mismanaged human healthcare, human stress and social disorder. More specifically, the US intelligence institutions had certain information about the forthcoming attempt to detonate an explosive device on the Northwest Airlines Flight 253 on Christmas Day 2009. Yet this information was not assembled in time by the right actors. President Obama described this failure to connect the dots as a Systemic challenge. This essay proposes a way forward for dealing with such challenges: a Systemic Information Logistics,

In the present age, often denoted as the Information Society, where more information is generated than ever before and where the generic significance of information as such has assumed a new order, a key question emerges: How can we secure that the right information is provided in a timely manner to the right actor? As a response to this question, several domains of academic studies and professional practices are reviewed here (Library, Communication, Information Literacy, Information, and Information Systems). This review shows that while these domains of studies and practices do contribute to an answer to the above question they still, regarded collectively, provide only a partial answer, and can thus not guarantee that the right information will be provided in time to the right actor.
On the other hand, Information Logistics is a more recent domain of studies and practice, and has presented itself as the domain that explicitly addresses the question dealt with in this study. A subsequent review and interrogation of Information Logistics shows that its theoretical body does advance our understanding and capability for providing the right information in a timely manner to the right actor. Yet, the inquiry also shows that Information Logistics is based upon assumptions that lack empirical validity, where one central assumption is that the future, and its information needs, may be predicted using means produced by human rationality.

The challenges to this rationality assumption have been addressed by various scholars, including H.A. Simon and C.W. Churchman, both of whom suggested some avenues for how to pursue our search for a resolution. While Simon’s proposal has lost its attractiveness, Churchman’s proposal has been adopted and further developed by various thinkers, including his student W. Ulrich with his Critical Systems Heuristics. The latter’s approach is not to conduct a heroic attempt to secure that the right information will be provided in time to the right actor, which is the attempted contribution of Information Logistics. Rather, Ulrich’s approach enables a systematic detection of the unconditionally inherent limitations in any design formulated by human rationality, including a solution for information provision.

In this sense, it is proposed that the current studies and practices of information logistics be empowered with Ulrich’s systemic approach, giving rise to Systemic Information Logistics. This constitutes a direction for a new research program with the potential to improve future human, social and industrial affairs.

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Stig Holmberg and me is of about the same age and we have both witnessed the raise and change of informatics, from study of “the methodology of the administrative data processing” to the diverse areas from Facebook, digital right management, information management to service oriented architecture. It has been a privilege I share with Stig to follow this process, even be in the centre of it. I argue we witness the transition from the old industrial society to the new network society. Last time such a transition occurred was 200 years ago. When I now try to describe the future of informatics it is inevitable that most of it deals with the current status, since this is the beginning of the future.

This article is based upon my introduction lecture when I became professor in 2002. Now it is almost 10 years later and the development has taken some steps further. It might be worthwhile to see if my ideas from that time still is valid and in what way they have to be changed. First I describe philosophic characteristics of the network society according to Castells, then the traditional information systems in this perspective leading to the core problem: Transfer of information between different systems. Then I try to identify a new type of information systems based upon the idea of experience exchange,

In fig 1 I have described the change of the number of employed people in different sectors over time in the western countries. The graph only indicates the changes. The green curve describe the decline of the agricultural workers from 80-90% 300 years ago to about 2% today. But these 2% produces considerably more than the 80-90% did 300 years ago. The same phenomenon can be seen for the industrial sector. So the question arise: What does the red line denote?
The industrial sector peaked during the 60’s. But already at that time people realised something will happened. The term “futurist” was coined already in the 40’s but was not common until the early 60’s:

In the mid-1940s the first professional “futurist” consulting institutions like RAND and SRI began to engage in long-range planning, systematic trend watching, scenario development, and visioning, at first under WWII military and government contract and, beginning in the 1950s, for private institutions and corporations. The period from the late 1940s to the mid-1960s laid the conceptual and methodological foundations of the modern futures studies field. Bertrand de Jouvenel’s The Art of Conjecture in 1963 and Dennis Gabor’s Inventing the Future in 1964 are considered key early works, and the first U.S. university course devoted entirely to the future was taught by futurist Alvin Toffler at The New School in 1966. (Wikipedia)

In the 60’s Jay Forrester also published a set of simulations, based upon a system theoretical perspective, showing that our civilisation was balancing on a sharp edge and there is an overwhelming risk for a global catastrophe (Forrester, 1961, 1968, 1969, 1971). Today, about 50 years later, the western world is still standing in glory and prosperity, although we have some crisis to take of. Forrester’s models was based on a traditional reductionist perspective and we have learned that this is not possible to apply. Toffler (1970, 1980) identified the need for change and predicted that those who would survive in the future were those who could adopt to changing conditions. As far as I can see, this is true. But there were also other types of predicitions. MacLuhan wrote for instance already 1964:

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Fig 1. Employment in different sectors over time

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Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extension of man - the technological simulation of consciousness, when the creative process of knowing will be collectively and corporately extended to the whole human society... (McLuhan, 1964)

When he wrote this Internet was not even conceived but it is a striking description of its capabilities.

Coming back to fig 1, what does the red line denote? In fig 2 a common economic model is described, showing similarities with the one I presented in fig 1. Here the advanced economy is attributed to the service sector. So the red line in fig 1 should denote "the service society". Seen from a transaction cost perspective (Coase 1937, Williams 1995) the transactions in the agricultural economy was mostly informal, clan based transactions (Nurminen 1990) while the transactions in the transitional economy is pure economical transactions. Typical for them is the exactness: When I buy something I know exactly the price, the delivery conditions, the payment conditions etc. A service transaction is, however, not possible to describe in this precise and exact way. A service is a procedure and unanticipated things might happened during the time it takes to execute the process.

Increase in the service sector might, however, be only a symptom of something deeper happening in the society. Castells (1996, 1997, 1998) claims this is the network society, an idea I strongly favoured in my installation lecture. He says that the network society is characterised by:

- Economical changes
- Flexible enterprises
- Co-operation in networks
- Reinforcement of the power of the capital
- One question society
- IT leading technical factor
- Increasing differences between poor and rich
- Global Mafioso
- Integrated, digitalised and Americanised culture
- Disguised politicians
- Religious fanatics
- Gender perspective

His analysis is based on a very meticulous study of many economies in the world. It is an impressive work getting much appreciation over the world.
The philosophical and societal background

The ideas of Castells was first published in 1996. It is now 15 years ago and considering the fact that one of the main ideas is a fast pace of changes we must surely see some signs of the change he predicted. In table 1 I have indicated which of his main characteristics I think is valid and why.
<table>
<thead>
<tr>
<th>Section</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economical changes</td>
<td>China is the biggest economy in the world, there are problems with the euro in Europe, USA has also big problems. We indeed experience big changes!</td>
</tr>
<tr>
<td>Flexible enterprises</td>
<td>The massive outsourcing I will later predicted has not taken place. Instead big companies are getting bigger and bigger. But we see a growing area of subcontractors, not only within the automotive industry. Also the market becomes more and more global even for physical things. Modern container ships can carry lots of goods to very low price each.</td>
</tr>
<tr>
<td>Co-operation in networks</td>
<td>Social networks such as Facebook and Twitter has increased considerably. It is also interesting to see the growing interest in professional networks, such as for instance LinkedIn.</td>
</tr>
<tr>
<td>Reinforcement of the power of the capital</td>
<td>The stock market is more and more important and there have for some years been a heavy focus on the short term benefits of a company.</td>
</tr>
<tr>
<td>One question society</td>
<td>In the news we see this phenomenon daily. There is a huge dominance of the “issue of today” in every newspaper and news program.</td>
</tr>
<tr>
<td>IT leading technical factor</td>
<td>IT is more and more taken for granted and hence the focus in research and support is not that prominent any more. I guess most people agree in the statement, but the focus is not only on IT but instead on other issues, where IT might play a crucial role of course!</td>
</tr>
<tr>
<td>Increasing differences between poor and rich</td>
<td>You can look in every economical magazine and find articles describing the increasing difference between rich and poor. Even in Sweden we have experienced this since the conservative government took over in 2006.</td>
</tr>
</tbody>
</table>
Global Mafioso

Five years ago there were much talk about the mafioso in different countries. Today this is not the case. It could mean the global mafioso is decreasing, but it could also mean they are smarter. However, there are reports from Italy that the mafioso in Sicily has lost many of its leading persons.

Integrated, digitalised and Americanised culture

In western Europe and probably in most of remaining parts in Europe the American dominance in movies, music and other entertainment is dominant. But despite that I have a feeling that it is diminishing. We see more and more movies from India, Japan and from the Arabic world. The Arabic countries seems to be more and more anti-USA.

Disguised politicians

I’m not sure what Castells means with this concept. The increased lobbying could be a sign of people disguising as politicians. But we see an increasing politicians contempt, which might lead to politicians being disguised; they don’t dare to show up in public.

Religious fanatics

We have many examples in the islamic countries, but also the fundamental christian movement in USA (the Tea Party movement) is getting more and more influence.

Gender perspective

In the beginning of the 21st century there were much talk about gender issues in the Swedish debate, but it has decreased lately. I have no ideas about the international status.

| Tab 1. Castell’s characteristics in our time |

However, I was not fully content with this analysis. The industrial revolution caused a deep change in society and not only in the manufacturing sector. So I looked for mechanisms for creating a society and came across Habermas’ ideas about reconstruction of society (Habermas 1972, 1984 and 1988). I realised that the traditional rational sense preserves the current structures and make genuine changes impossible. This lead my thoughts to Critical Theory (Horkheimer & Adorno, 1981). However, they do not come up with suggestions for a new society,
something that Habermas do. Besides, he starts with a critique of the critical theory.

A theory for the reconstruction of society should be transparent, i.e. it should be able to both explain and criticise society relaying only on itself, thus avoiding the dilemma of Russell’s antinomy (Russell 1903). It should also comprise the whole society, i.e. also ethical and moral issues, especially since it is much talk about it in the so called new economy (Keen 2001, Kelly 1998). Habermas finds the basis for this theory in the “communicative rationality” since it is by communication the society is created and re-created.

I came across Habermas in the 80s, when I was working on my PhD-thesis. I was very much fascinated by his knowledge interests:

**Instrumental interest**, based on positivism and corresponds to the work-sphere in human life.

**Practical interest**, aiming at understanding humans, based on hermeneutics.

**Emancipatory interest**, aiming at emancipation from oppressing structures and matters in society. It seems to require admittance to the other two.

Based upon this Habermas identifies three worlds:

The **objective** world where facts matter – objective attitude, instrumental acts. This is the world where we work. It is sometimes also called “*system world*” and is based on a technical knowledge interest.

The **social world**, where norms and values exist – normative attitude, normative acts. This corresponds to the practical knowledge interest

The **subjective world**, our feelings and expectations – expressive attitude, dramatical acts. In this world we can emancipate ourselves, this is where genuine development take place.

In the world of today the focus is on the System, the objective world, money and power. It means that the instrumental acts and language penetrates into the normative and dramatical part of our subjective world. Put in other words: The difference between work and leisure time tends to diminish. Everyday life becomes commercialised and bureaucratised due to the influence from the systems. Since the rules are in a certain way, since the computer system is designed in a specific way we have to follow that road, even if we admit that it is not the optimal or maybe not even a desirable road.

Expert cultures fragments the social and subjective world. We have experts on computers, work flow, child nursing, home care, welding, sexlife etc. Every expert put forward his or her expertise as being the most important (cf. one question society according to Castells). This makes our world impossible to survey: An increasing flow of information, an increasing flow of expertise, an accelerating
development make society impossible to overview. We feel in our subjective world that changes is really needed.

Traditional development is based on economy and the conditions of work. Power and money have great influence. Using this development mechanisms for change only reinforce the alienation and verfremdung we encounter in the modern world. To achieve a true emancipation new mechanisms for control is needed. These mechanisms must be based in the subjective world; the world of humans.

Habermas identifies such a mechanism: **Solidarity!** Probably the key element for survival of mankind. It is a connecting and integrating force, leading to a sustainable society. Looking at the problems we face today with climate change, lack of democracy, neglecting human rights, uneven distribution of resources they can all be attributed to lack of solidarity. Selfish, egoistic behaviour lead to most of the problems we see today. So solidarity should be the basis of the new society. Can we see any signs of that?

In 2002, when I gave my installation lecture I saw very few such signs, but maybe we can identify some hopeful tendencies today. First I will point at the democracy movement in the Arab world. We have by no means seen the end of it, but the fact that many people together engage in the protest movement and dare to go against military forces demonstrates a high degree of solidarity. Also the social networks where we freely share private information is a sign of trust and hence also a solidarity. The new economy also talks a lot about sharing values and create relations with the customers. Finally the public sector, which become more and more important is based on solidarity.

**Information systems in the new society**

The next question I raised in the lecture was this:

*Suppose we enter a network economy according to Castells. What type of information systems is needed in such a society?*

It should be noted that I use the world “information systems” in the same meaning as we did in the 70s: Computer based information processing systems used for support and control of the work of commercial organisation. I exclude this systems like Facebook, Twitter, YouTube, Linkedin etc. I also exclude public data processing systems since I at that time was unaware of their characteristics.

As a starting departure in the answering process I described in my lecture the characteristics for the IT-systems of today, the type of systems we are talking about in our teaching. I defined them as transaction-based information systems which are the result of traditional systems development. However, today we very seldom see systems development from scratch in the way we usually teach in our introductory courses. Instead they are often standardised, supposed to fit in different
companies. In those system information about every business activity is stored in a database. Hence, those systems are very valuable.

A typical business transaction: order of stuff to a company, was described in an animation in my lecture. The process was described something like this (fig 3):

The red company orders some stuff from the green company (1). It is received by the sales department, who then asks the manufacture department if the stuff is available (2). The manufacture department checks in the store (3) and let us suppose the stuff is not there. Then it has to be manufactured and raw material has to be bought. The manufacture department then ask the purchase department to buy the raw material (4). When this is done, the material delivered and the ordered parts are manufactured they are put in the store (5) and from there delivered to the customer (6). In the meantime economical information are collected by the economy department to provide a correct billing base (7), if not for this order so at least for future orders. Invoice are sent (8) and later payment is received (9).

In this main process I identified several transaction costs:

- The order is printed on paper, checked with the store and the information from the data system, put in an envelope and send to the vendor by post.

![Fig 3.A traditional transaction between two companies](image-url)
• On arrival the vendor enter the order into his computer system, checks if it is ordered correct and an order acknowledgement is written on paper. This paper is checked with the original order to see if it is the same. Then the order acknowledgement is sent to the customer.

• The customer receives the order conformation and check if it is the same as the original order. Then it is entered into his computer system.

• In manufacturing process we have some internal transactions between production, purchase and storage departments, but they are carried out more or less automatically in the ERP-system of the company.

• When the stuff is shipped to the customer a packing list is produced and it is checked against the original order and shipped with gods to the customer. On arrival the customer compare the packing list with the delivered stuff in order to control the correctness of the list. The packing list also is used for producing a correct invoice send to the customer. When he receives the invoice it is checked with the packing list, the original order and the reports from the storage. Then the invoice is payed.

We see as soon as information leaves the company it has to be checked and when it arrives at the other company it also have to be checked. Considering a big company having several thousands of transaction each month, yes even every week, big money can be saved if transaction costs are reduced.

When the idea of supply chain was introduced in the 80’s (Porter 1980) another argument was provided for integration of the information processing over the whole supply chain. But surprisingly enough, not very much action was taken within informatics in order to incorporate the ideas. We taught our students how to develop information systems from scratch, despite the fact that very few companies could afford it. In fact the supply chain model requires trust and loyalty between the companies in the supply chain. Those who achieved this gained huge competitive advantages, while those companies still dwelling in the old-fashioned protective paradigm was outrun.

1995 internet made its great commercial breakthrough. I dare to argue that this is to be compared with James Watts steam engine in the perspective of starting a new era. The steam engine started the industrial era, internet started the next era, the network society. Using internet you can move information from one place to another irrespective of distance and to the cost of almost zero. This opens great possibilities. Suppose we could connect the information systems of two companies via internet. Then the transactions could be carried out at no cost instead of the cumbersome and costly manual routines we have described earlier. Also quite new types of systems could be created. But an important prerequisite is that information can be transferred with preserved meaning.
Information transfer between information systems

To move information from one system to another is by no means a simple task. Many vendors try to lock in the customers by not telling the format of the data for instance. The reasons are strictly economic: Instead of helping the customer transfer his information to another competitive system they want him to buy their version of the same system. Especially in the public sector this is very common, because the total market is rather limited. Many times the companies have to develop special solutions and create special software to do the mapping.

Mapping with and without middleware

We realise immediately that if a company should do business with many other companies many mapping routines have to be developed (fig 4, left side). But if we introduce a common and standardised middleware, then the mapping could be done very cheap. The problem is of course to identify, agree upon and develop a such middleware.

In fact, such middleware have existed since the middle of the 80’s. It is called EDI and the specific format for invoices is called EDIFACT. The trick was to create an invoice format containing virtually every possible field that could be thought of. The system was thus very cumbersome, required a lot of work and was also very expensive to use since it was using dedicated phone lines. Today simpler formats have been developed, using internet. Now e-business is carried out according to fig 5. Information we here define as data in a structure with a certain content (Flensburg 2009). For the data and structure levels we have good performing Web Services and for the content level we have meta-data. But the companies have to agree upon the choice of standards for meta-data (ontologies) and this is not so common yet.
A problem not solved, but realised is the mapping on the ontological level. I have tried to develop an enhanced communication model in order to better handle and understand the importance of ontological mapping (Flensburg, 2009). But let us for a moment suppose these problems can be solved. Let us also assume the network society will be realised. Before we answer the question about the type of information systems we have to consider another question:

*How would the business processes look like in a network society where adequate information mapping is possible?*

**New business models**

Since information can be transferred everywhere at cost almost zero, this means that information processing can be carried out anywhere on earth. This opens up for outsourcing of specialised parts of the company. Looking at our example in fig 1, the green company might now be divided into several specialised parts (fig 6). For instance the economy function is divided into “credit control”, “book keeping” and “invoices”. Each of them is highly specialised and can perform the function for
many other companies also (white rectangles) and to a cheaper price and with better quality than a general economy department can do.

The same applies also for the other departments, here just indicated. The company is then just a brand, rather few people who has designed a business process for producing just this thing they want to sell. We have several of such companies today, both Gantt and Peak Performance works that way.

Specialised parts of the company

Also the red company could be outsourced. We then end up with a picture like fig 7 where we have a lot of highly specialised companies doing their specialised part of a business process and serving many processes containing that part. The processes are marked with different colours. This put high demands on the companies since they are to serve and be loyal to several supply chains and they should be able to switch from one to another almost instantly and with a change cost of almost zero. In the traditional informatics way, you initiate a two year systems development project for every change of supply chain. This is not possible any longer and we need models for such fast switches.

In order to keep track of all business processes we introduce a business process repository, describing all business processes. It could be a fix description, saying which companies will do what part, but it could also be dynamic and allocate resources in a more optimal way. An exiting scenario could be possibility to change the process during its execution!
There are of course several problems in doing this. One such problem is the difficulties to describe the processes in enough detail and with all aspects. For the business market this should be possible, but for the public sector it is very difficult, if even possible. We have seen some efforts applying business views on the public sector where the result was by no means close to the expected (Halin & Siverbo, 2003, Ruland & Larsson 2002).

This was my vision concerning the core area in informatics in 2002. At that time I was by no means to only one with similar visions and the development since then have shown it was not completely wrong. SOA (Service Oriented Architecture) was during 2006-2009 a really hot topic, but progress and use of it was not in the expected pace. I predicted in 2002 that the ontological mapping would be the most important and the most difficult to do and we don’t see any real progress in that area today. I haven’t seen any coherent approach based upon a development of a common ontology. In that sense my vision still needs to be fulfilled.

What I did not foresee, was the strong focus on public IT, e-governance, we see today. The reason was simply that I was not aware of the specific character of the transactions in the public sector. They are with almost no exception, service transactions and as I indicated in the beginning of this article, they can’t be described in the clear, precise and exact way as is required for business transactions. Believing so cause much wasted efforts and human suffering. Hence, my vision is only valid for the business sector.
Research questions

In an installation lecture you are supposed to outline a research program and so did I. I suggested an area of important research questions:

**The long range sustainability**: Sustainability was very important in those days and since everybody knew I was a member of the green party I simply had to put it in the first place in order to be politically correct. But I did not said much about it. Besides, sustainability can be considered as a parent goal to other goals so in that sense it was motivated. Seen in a retrospective perspective it is a good example of disguised politician ;-)  

**Reconciliation of business processes**: This was more in line with my presentation. I identified a need for describing the business process, to identify its availability and who was in charge of it. This is the base for the next issue:  

**Reconciliation of the mapped information**: I identified reconciliation of the meaning of the concepts, of the existence or not and the algorithms used for computation.

**Information logistics**: At that time we were much interested in information logistics and I tried to initiate a research program within the area. It was about keeping track of the information and providing the right information to the right person in the right time and in the right place, in the right format and to the right cost.

**Security problems**: Always when I talked about my visions there were questions about security issues. Here I talked about to ensure the availability of the information, the authorisation of it and above all: The correctness of it. But I have to admit I’m (and is still) not very interested in these issues.

**Standardising** was however something I found interesting. Which techniques, methods and models will be accepted? Will component based software be a possible solution? And most important: What are the consequences of standardising?  

Now, 9 years later, which, if any, of these research questions did I managed to deal with? Surprisingly enough, most of them I declared an interest in. I was involved in a project financed by VINNOVA, resulting in a good overview and understanding of the reconciliation of information was developed. A course and about 500 p course material was produced. I was also involved in an EU-project about creating ontology based and integrated work flow for the automotive industry. We came up with a prototype, which turned out to be a much more generalised product than anticipated. But it could not be fully developed, since our software partners had no idea of how to create an ontology based software. Unfortunately we had neither... But the conceptual model was further developed.
in a PhD-thesis (Mosnik 2010a) and it was also used in the public sector, at a Swedish municipality (Mosnik 2010b).

**IT and the new society**

I have so far given some reasons why I think solidarity will be (or rather must be!) the integrating force in the new network society, despite the fact we today see very little solidarity, at least in the western countries. I have also described the new core of informatics, transaction processing in private companies. During the analysis a new perspective on the question have raised. Instead of only asking how the information systems in this new society looks like we acknowledge IT:s huge power to form our society, work life and even subjective world. Now I will instead ask how IT can be used to re-construct the society so we achieve a society based upon solidarity, sustainability and sharing of wealth? The role of science in this process is to indicate possibilities but also dangerous things, areas where it might go very wrong. It is a normative approach, different from traditional, value-free science. Both courage and wisdom is required!

Our point of departure is the business model, described in fig 7. In order to work each actor within the network must trust the others and also behave in a trustworthy manner, in short the network requires solidarity from its members! The routine based economical transaction are taken care of by the followers of the traditional ERP-systems, now based on a SOA architecture and very open towards the environment. This also requires trust, loyalty and solidarity from the members of the network. The technology forces a solidarity.

Due to high degree of automation every human worker becomes more and more important. Their work is important, requiring review and assessment capabilities. They add the human dimension to business and service in the public sector. The most desired capability is knowledge and ability to deal with unforeseen situations. Hence experience becomes a very valuable asset. Experience means in this context ability to deal with unusual situations. In fig 8 I have a sketch of an experience recovery system. The basic source of experience recovery are the unusual business (or service) transactions that takes place and require human attention. This is the inner loop and the clerk learns how to deal with these cases. The business strategy influence actions taken but the experience might also lead to a change of the business strategy. There is also another important source, namely data mining the databases of the traditional ERP-system. This means discovery of unknown and unexpected dependencies in the business. Here a skilled analyst could discover much.
Experience recovery systems

Experience is a valuable asset and in the same way as its value increases, the documentation of it is necessary. Therefore, I think some kind of experience systems is needed. Today, they are called competence systems, centralised systems documenting the competence of the employees, but I think personal competence systems is needed. Since the new society is based on solidarity I also think people are willing to share at least some of their experience in a common experience base. It is to be noted that if we share experience the total value is increasing!

Do we see any indications today of this new way of thinking? In big companies we see an increasing interest for competence and knowledge management (Pareto & Snis, 2006, 2007). In small and middle sized companies often forms network (Berggren et al 1998, Herman et al 2010) where the companies both support each other as well as they compete. The key success factor is a well integrated work and learning; Work integrated learning!. It is a true multi-science and cross-science area containing elements from informatics, pedagogy, social science, culture science, nursing science and sociology. At University West it has grown from a ten years research and in June 2011 we were allowed to give PhD-exams in the area!

Earlier wealth were created by manufacturing gadgets; today wealth is shaped by “value creating activities” based upon shared values, experiences, support etc. between human beings. Earlier the wealth was in the vaults in the banks, today it is in the head of the people and on the disks of the computers! It is to be noted that it is the customer who is the driving force in the value creation. These values will be much more based on solidarity with developing countries, with
underprivileged and with the future generations possibility to survive. This forms the new network society!

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Loop or branch

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ABSTRACT

Professor Stig Holmberg had a certain role in shaping and teaching the modern information systems culture where search and organization no more obeys patterns of branches and hierarchies. Among other things, he influenced my methodological thinking by criticising and suggesting modifications to my methods taxonomy in the 1980s, later established in practice and in a doctoral thesis. This was before the exploding development of the Internet where it become natural, even fundamental and generic, to search and shape methodology without any pre-set hierarchies. A resume of Stig’s and my discussions may have not only a historical interest but also still be of a non-trivial value in modern ventures as a generic pattern for projects of design and for strategic analyses.

Keywords: Information system, design, analysis, loop, branch.

1. INTRODUCTION

Stig Holmberg grew up with computers and taught information systems at the University of Östersund. He also had a role in the civil defense and with the Defense University. I had a role as an integrated civilian in the design of defense systems with the National Defense Research Establishment. Stig and I worked together with systems methodologies, with defense problems and in the framework of the Swedish Operational Research Society, SOAF. Sometimes, we worked in Stig’s stimulating and well-equipped office at home.

A recurrent theme for us was the combination of methods in complex studies, where we shared a common scepticism for the exaggerated but common belief in the value of complex simulation models. We observed and criticized such efforts in our environment, like Materielverket’s IT4-project, which had the ambition of simulating all kinds of tactical operations by one model.

We were shocked when we heard their presentations and their estimates of budget saying “just let us enter just a few more parameters into our model. Then we will
have a generally valid instrument for the description and assessment of troop and systems in the most important situations.” Of course, this project simply faded away and the symbol of IT4 was taken over by other parties. It may be a comfort for Sweden although the interest in mega-modeling persisted longer in the USA than here. In Sweden, the interest in a tentative use of smaller models and war gaming with a more direct human control came back. Relevance substituted generality.

Our view of combining methods was original at that time. We combined models and methods pragmatically. The different purposes of the joining methods should support each other with defendable coherence, and assumption should be accounted for in this means – ends setting. This is how we made explicit the relations between the different parts of a study. No deeper epistemology was or is needed. This is how the epistemology of applied projects was disposed of. Combining methods is an evidence nowadays, but how to make sense and to define purposes with them may still deserve some non-obvious cogitation.

We published the article Operational research in Swedish military long-term and complex development projects in 1998. (Agrell, P. S., Holmberg S. C.) Here, we focused on the purposes of an acting bureaucracy as a complement to the more usual cost, effectiveness and operational research criteria attributable to the studied systems. This reflecting focus on the actors was not so current with operational research at that time but that was the way to reconcile the ambitions of relevance and sufficient simplicity. This specific focus had and has its importance to guide the form, the content and the choice of criteria in a professional systems design project.

Stig’s critics of my initially hierarchical approach found support in the examples we could find within the world of so-called studies with the military host organization. The combinations of war gaming and game theory were the most striking examples of the reciprocal methods view Stig wanted to introduce into our methodology. Most episodes of an item of a war game can be described or at least illustrated by the simpler formalism of game theory. Conversely, the reciprocity comes when the game theory is made the framing top of a set of war gaming exercises. Gaming applied to the estimations required with a formalizing game theory would surely only give proxy answers. In the perspective of an inverse framing, the game theory analysis of an episode in the game would above all have to be interpreted with reference to the necessarily limited number of dimensions possible to capture by the existing game theory. However, approximations can be seen but useful interpretations are often possible!

I experienced a similar reciprocal duality with the elaboration of a new Swedish defense doctrine in the beginning of the 2010s. This doctrine had the supreme role to summarize the entire Swedish defense organization and its possible activities in war and peace in one document. At the same time, this book of a doctrine became
an instrument among others for change and development of this important host organization towards very different roles with diplomacy, interventions and new forms of civilian cooperation.

More generally, this reciprocal relation between outer and inner methods framing each other was drawn metaphorically as a Klein’s bottle: Facts, methods, processes and culture were drawn into a loop, where the non-obvious link was the connection between facts and culture. Facts in this image are represented as produced in a cultural/subjective framing. At the same time, there are facts about culture. This way, the methodological picture becomes more of a helix than a circle. Facts are produced in a culture which may be described factually but subjectively conditioned and framed by another culture (or sometimes by the same culture). Just to explain the metaphor, and without any practical significance, we can compare it with a couple of mirrors facing each other, imaging each other in an eternal chain.

Once, when I had a role with the University of Lincoln, the drawing of this bottle came to resemble a music instrument, a tuba, during a lecture, and then I got the question: “How do you play it?” The answer to this very good question then would have been to rely on the reciprocal relation between methodological acts. They help finding each other; they even frame and shape. They make sense of each other. This would be the essence of the design and operation of a project by our methodology. No act or piece of method in this one would follow a recipe, independently of its methodological neighborhood. Every analysis would depend on a context of reciprocally dependent methods, acts and purposes. The possibility of methods being contained in each other is not jeopardized by this, but it does boil down to a matter of perspectives. It is up to the analyst/planner/project leader to decide how he or she wants to make sense of each item of method and especially how to make sense of major items offered to a client.

There may be an epistemology attached to each method identified, but this does not deprive the user of the possibility or even the obligation to make a purposeful subjective sense of it. There is, as with all texts, an author’s intention and there is a reader’s intention. For each act and for each method, the staff of the project has to make sense of it. Make! And see the difference between a process and a method. The process of a project should expose understanding and will. We are free to do this even though it is subject to contracts and audit.

This is how I wish I had answered the difficult question about how to play it. What I did say was instead something more general about the role of models in methodology. I am as grateful to my hosts at the University of Lincoln as I am to Stig for this friendly push into a lasting research interest: How to make sense.

To make sense is a key issue in the more or less reciprocal methods taxonomy of Stig and me, so let us offer the really obvious illustration. Suppose we are given
the number four (4). What does it mean? It is difficult to say if we do not know whether it is meant as a number or a size. But let us give you the freedom to decide its sense. That makes it easy. If you have a real interest in it, you may decide whether it should be a number or a size, a measurement or a score, a reference or a reality, truth or fiction. If you are not the author, you may even argue with him or her what significance it should have. You may even disagree and that would surely be beneficial. Both parties should have their liberties.

Let us also make a reference to literature! This science cultivates the concept of genre which means kind of literature, the type of literature the author intends to produce. Mostly, this is done without recognizing the role of the reader or reducing it to something imagined by the mind of the author. The concept of genre is important for us in management and also as systems scientists, since it distinguishes and separates the content and the intention of a text. However, as analysts and advisors, it is important to give power to the user of the information. We should all have the power to define intentions and thus to search, find and make sense of relevant information. We must have this power in order to face our whole spectrum of clients and audit.

What then about the scientific ambitions towards truth? Well, it is still there and as with all science dependent on the situation and on other conditions. Let us approach the defendable truth, not the absolute one, but do it seriously. Let us try the transparent truth and what politics sometimes calls for, although too seldom. We have the terrible opaque consensus methodologies instead.

Without any desire to impeach the common truth concept, the idea of making sense should be given its place here. It is necessary in order to save decision making from both the popular superficial consensus methodology which has not got the power of transparence which would serve democracy and from the big “Mädchen für alles” models which are too complex to be sense of.

As an example of management of truth, let us consider optimization and simulation. Neither gives the whole truth and seldom a trustworthy advice. Especially the optimization offers perverted side effects (even though mathematically correct), and a simulation never captures all local circumstances. Even the very mature science of statistics is criticized. We have the well-known anecdotes of statistics as a lie. But all these methods are well-defined, transparent! That makes them fit for democracy. Only they must be made sense of. Politicians and other decision makers should not be too ignorant. That does not mean that they must know much about relatively difficult methods. However, to know enough to see purposes and to make sense is important. That should be taught widely in society, even to the deep methodological specialists. Efforts are needed in order to recreate abilities to decide. Neither the modern superficial consensus proceedings nor any direct modeling is sufficient for our time. This is my point of
view. Stig may agree or not, but so far, I can only say that he has given me some initial inspiration.

This way, the design of projects and systems is not a matter of simple fitting together methods and models. There are always issues about interpretations between those. This was true for my original hierarchical methods taxonomy and it is true for the reciprocal modification initiated by Stig.

Still, I would say that generally, any method is better than no method and also, you will know what you have done, for the benefit of continuing improvements and critics. This is the honest way and it opens up for democracy. Democracy is not only the condition where those present have come to an agreement. It is the understanding and the communication in larger contexts. So let us hope that the systems science efforts of the kind Stig and I exercise will continue and find appropriate applications.

A final comment must be added: This is my view of a piece of history. Stig might see it otherwise. But it is as close to the truth as I have been able to tell it. Now it is up to the reader to make sense of the article. He or she may for example get some methodological inspiration without bothering too much about what others may see as provocations.

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Issues of emotion and usability of interactive artefacts in HCI

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ABSTRACT

This chapter presents the limitations of traditional usability methods for interactive artefacts (e.g. smart phones, iPods) in HCI. The purpose is to propose the emotional aspects of usability measure of interactive artefacts. The first part of the chapter illustrates emotions in HCI from a theoretical point of view, the second part focuses on the measurement of emotions in HCI, and the final part discusses how emotions can be incorporated in the usability evaluation of interactive artefacts in HCI.

Keywords: Emotion, artefacts, usability, HCI

1. INTRODUCTION

Helander and Khalid (2006) point out that most studies on design in HCI have focused on user needs concerning functionality and utility, and less on emotion. Cognitive approaches to usability have underestimated the importance of user emotions in design. Utility is the query of whether the functionality of an interactive system in principle can do what is needed and usability is the question of how well the user can use that functionality (Dormann, 2000).

Hassenzahl and Tractinsky (2006) asked a challenging question: in what way can we design a positive experience in a certain way? Can designers use enough control over all relevant aspects and take these into consideration while designing? Another question is; how can we design products in such a way that positive experiences are ascribed to the quality of an interactive artefact?

Usability experts have largely relied on usability tests and subjective questionnaires to measure user satisfaction and emotions (De Lera and Garreta-Domingo, 2007).

A number of studies have been published that uses the limits of traditional usability methods to explain and evaluate emotions (Kalbach, 2006; Yilmaz, 2006;
1.1 Limit with traditional usability

An interface may bring out a variety of emotions ranging from joy or fear, to trustworthiness or sophistication. Usability does not cover the whole range of emotions that can be linked to the human experience. Within usability, emotion evaluation mainly concerned the unpleasant-pleasant dimension (Dormann, 2000).

Dormann (2001) assumed that users evaluate the application on the cognitive level (e.g. in terms of success with a task, and low rate of errors made while using the application) and users experience satisfaction on the affective level based on the cognitive evaluation of the application qualities.

1.1.1 Satisfaction

In HCI, the term satisfaction is often used synonymously with the perceived usability or at least with the overall evaluation of a product Hassenzahl (2004).

Regardless of the HCI efforts, when defining satisfaction, there is no accepted operational model accessible that would be able to describe the key fundamentals of the user experience. Generally established definitions of usability by ISO 9241–11 (1998) do not take the subjective side of user experience and less still hedonic aspects into consideration. Hassenzahl (2004) argues that the definition of satisfaction, the subjective part of usability, lacks the building up of empirical knowledge about the user experience of artefacts. One way to tackle the problem is the user’s perspective to satisfying their consuming activities. Another perspective is the user’s interaction with the interactive artefacts through its usage.

2. THEORETICAL FRAMEWORK OF EMOTION IN HCI

2.1 Artefacts and emotion

The interactive artefacts (e.g. colorful smart phones) bring pleasure to the lives of people. The interactive artefacts are not only physical entities, but also affect our lives in a positive way. These products have more than a suitable functionality; they provide emotional and esthetic qualities (Sevener, 2003).

One important role of an artefact is to support and extend the cognitive abilities

Rafaeli and Vilnai-Yavetz (2004) suggest that artefacts engage emotions in the following three ways: instrumentality, this artefact helps achieve a task; esthetics, a sensory reaction to the artefact; and images, association the artefact reveals.

Emotion is multifaceted and may include the following features; behavioral, expressive, and physiological reactions and subjective emotions (Helander et al., 2006; De Lera et al., 2007).

According to Tomkins (1962), there are at least eight basic emotions (fear, anger, anguish, joy, disgust, surpass, interest and shame), and other emotions are a mixture of these basic emotions. Some authors refer to continuous dimensions of emotions (arousal (calm/excite) and valence (negative/positive) (Dormann, 2000).

Helander and Tham (2003) express the changeover to the affective interaction as related to performance and physical or psychological pain. Helander et al. (2003), Norman (2004), and Jaasko and Mattelmaki (2003) present a framework for a user experience of positive effects (pleasure) of interactive artefacts.

2.1.1 User and interactive artefacts
User experience is about what occurs between a user, an artefact and an overall activity within a context. Figure 1 shows how an interactive artefact is a mediator between the users and their activities. The artefact is an agent used to perform an activity (Gomez et al., 2004).

![Figure 1. User experience in the context of artefact and activity (Gomez et al., 2004).](image-url)
2.2 Cognitive and social emotions

In comparison with basic emotions, the cognitive ones have a higher degree of evaluation because they are not reflex reactions; they vary from one culture to another, from one individual to another. Guilt, shame, embarrassment and jealousy are examples of cognitive and social emotions. These kinds of emotions play an important role in adjusting the social behaviors (Cristescu, 2008).

There is evidence that people perceive reality in at least two ways, one is emotional and the other is cognitive. Different cultural groups may have different population stereotypes, for example, Chinese participants relied on visual elements and symbols when using mobile services, whereas Finnish participants preferred explicit information and a text mode.

2.3 Physiology of emotion

A long history of research has been done in attempting to use physiological data to identify emotional states (Cacioppo, Berntson, Larsen, Poehlmann and Ito, 2000) and evidence shows that it makes a lot of difference among a number of emotions (Levenson, 1992).

Cristescu (2008) stated that progress in the field of neurosciences shows that the information processing in the neocortex is slower than when processing it in the emotional brain and the number of connections from the limbic system to the neocortex is larger than the opposite way from the limbic system towards neocortex. Using functional Magnetic Resonance Imaging, the assertion that cognition and emotions are unified was confirmed (Helander et al., 2006; Rafaeli et al., 2004).

3. MEASUREMENT OF EMOTION

Emotion is a set of interactions with subjective and objective factors, mediated by neural systems, which can give rise to feelings of arousal, pleasure or displeasure, produce cognitive processes, such as emotionally relevant perceptual effects, activate extensive physiological change to the arousing conditions, and lead to behavior that is goal-directed and adaptive. A variety of methods are used to measure emotion, and they can be categorized as subjective, objective and physiological (Bagnara and Smith, 2006; Helander, et al., 2006; Pikery, 2005).

3.1 Subjective measures of emotion

The most common methods used are questionnaires, adjective checklists and different types of emotional scale: semantic differential scale, unipolar scale or free labeling (e.g. Kansei Engineering and Semantic Scales) (Dormann, 2000; Helander, et al., 2006).
Other measures use graphical representation of, for instance, happy and sad faces (Bradley and Lang 2000). Such scales have the advantage of being understood by different populations in different cultures (Pikery, 2005; Dormann, 2000).

3.2 Objective measure of emotion

Two accepted methods to record emotions are: analysis of facial expressions and vocal content of speech or voice expressions (Helander, et al., 2006). The facial expressions give information about the emotional state, such as enjoyment, surprise, sadness, disgust, euphoria, and irritability, cognitive states as perplexity, concentration, or boredom, and temperament and also personality traits such as hostility, and sociability (Helander, et al., 2006).

The style of the voice, such as pitch, loudness, tone, and timing, can convey information about the speaker’s emotional state (Helander, et al., 2006). When products result in positive user experiences, the emotional affects are often more important to the user than an increase in efficiency and effectiveness (ISO 9241-11, 1998; Helander, et al., 2006).

3.3 Physiological measure of emotion

Physiological metrics have only recently been used in the domain of HCI. We can evaluate users’ eye gaze and collect electro physiologic signals, galvanic skin response (GSR), electrocardiography (EKG), electroencephalography (EEG) and electromyography (EMG) data, blood volume pulse, heart rate or respiration and, more recently, facial recognition software (De Lera et al., 2007).

Researchers have used GSR and cardiovascular measures to examine subjective response to video and audio degradations in video conferencing software (Wilson and Sasse, 2000a, b), and to investigate user response to well- and ill- designed web pages (Ward and Marsden, 2003). Partala and Surakka (2004) measured EMG activity on the face in response to positive, negative, or no audio intervention (Wilson and Sasse, 2000).

Based on previous research on the use of psycho-physiological techniques, we believe that capturing, measuring, and analyzing autonomic nervous system activity will provide researchers and developers of technological systems with continuous access to the emotional experience of the user (Wilson et al., 2000).

Hazlett (2003) describes how facial EMG sensors were used to detect facial emotional responses while the subjects performed tasks on websites.

4. EMOTIONAL USABILITY

We need to modify existing usability methodologies to fit interactive artefacts (Dormann, 2000). Several researchers and practitioners advocate to consider the impact of emotions on a user’s overall experience when interacting with interactive
We present three possible models that demonstrate emotional measurements of usability on interactive artefacts. The first one is a triad model by Izard (1977), the second is an emotional design model by the author, and the final is an esthetic model of usability related to Norman (2004).

4.1 Emotion triad model

The “emotion triad” model (Izard, 1977; Sascha et al., 2006) in figure 2 comprises subjective feelings, physiological activation, and motor expressions.

![Emotional triad model by Izard (1977).](image)

This model has three aspects in common: a focus on the subjective side of usability (user perceptions and experiences); on the positive sides of using products (instead of simply avoiding usability problems), and on user needs as a whole. Especially the last perspective, on users’ requirements and needs, focuses not only on efficiency but also on effectiveness (Hassenzahl, 2004).

Hassenzahl (2004) argues that products (e.g. interactive artefacts) with a specific effect in a special situation will lead to consequences, such as emotions (e.g. satisfaction, pleasure), explicit evaluations (e.g. judgments of appeal, beauty, goodness), or overt behavior (e.g. approach, avoidance).
4.2 Design emotion model

Both the emotional and cognitive experience of the design is included in the model in figure 3.

![Figure 3. Emotion design model.](image)

According to the model, the lowest level of need is functionality, followed by traditional usability criterions. The extended component to the traditional usability model that follows ISO-standard (ISO 9241-11, 1998) is the design of interactive artefacts, including both emotional and cognitive factors, to improve the user experience of the product.

4.3 Esthetics model of emotion

Esthetics is scientifically defined as the study of sensory-emotional values; but on the other hand, esthetics can also be defined as the study of the psychological responses to beauty and artistic experiences. The definition of esthetics includes terms like feeling, culture, learn, perception, and experience, and a form of pleasure experienced in response to an object (Bertelsen, 2004; Frohlich, 2004; Yilmaz, 2006).
If emotions are derived from esthetics and cognitions from the usability of the interactive artefacts, usability perceptions would most likely be influenced by the esthetics of the interactive artefacts, according to the model in figure 4.

Figure 4. Esthetics model of perceived usability relation (Yilmaz, 2006).

5 CONCLUSION REMARKS

This chapter reconsiders different emotions incorporated in design for interactive artefacts and discusses the importance of emotional usability. Traditional cognitive approaches to usability have tended to undervalue the emotion of user experience.

The emotion of design is a critical part to be able to verify the experience of interactive artefacts. Emotions play a significant role in the perceived experience with interactive artefacts (Norman, 2004), and mediate user performing (Spillers, 2003). The emotional aspects of usability give usability experts and interaction designer more reliable and valid findings of the user’s experience of interactive artefacts (De Lera et al., 2007).

New mobile technology makes physiological measurements of emotions both cheaper and easier to use in the future (Hassenzahl, 2004; Dormann, 2000; De Lera et al., 2007). Interactive design that provides the requested esthetic pleasure and satisfaction can significantly improve the results of the interactive artefacts and make them successful.

Research on the cultural effects of emotions and individual reactions is an important challenge in the future. To improve the knowledge in this area, it is reasonable to suggest that researchers (Cristecu, 2008) take emotions into account (Lin, 2004). The challenge is to initiate more interdisciplinary research in the field of emotion to obtain more knowledge in the design and usability evaluation of interactive artefacts in HCI.
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On journey with system thinkers - Systems thinking in education and research, today and tomorrow

“Challenges for the future in an ICT context”

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ABSTRACT

This contribution describes and discusses how some approaches from Systems Thinking\(^{23}\) have been used in higher education in Informatics with the aim to broaden the course content and give the students a toolbox to use in the future. The courses have been offered at Mid Sweden University\(^{24}\). Future use of Systems Thinking in higher education – both in traditional campus education and also in eLearning (distance courses where the communication is supported by some kind of ICT) - is discussed. Some ongoing research related to technical communication where Systems Thinking has been used, is presented and finally, the concept of critical information is related to Systems Thinking. The latter concept is a core concept for the research group in Informatics, Campus Östersund. This contribution is dedicated to Professor Stig C Holmberg, who has been the “architect” and source of inspiration due to his design and realization of courses in informatics.

Keywords: systems thinking, course development, higher education, critical information

\(^{23}\) I will use the concept “Systems Thinking” throughout this chapter. Different Systems Approaches such as Soft Systems Methodology (Checkland, 1981), Viable Systems Model (Beer, 1972; 1974), and Reflection in Practice (Schön, 1983) is included in my use of the concept Systems Thinking.

\(^{24}\) One of the courses – Communication in learning organizations – is in collaboration with Blekinge Institute of Technology. The course was designed and manned with representatives from Informatics at Campus Östersund, Mid Sweden University.
1. INTRODUCTION

The theme for this booklet is “Challenges for the future in an ICT context”. This is a broad theme and it was also meant to be broad in our early discussions. Research within the Department of Informatics at Mid Sweden University, Campus Östersund, has recently been formed under the “umbrella” – Critical Information and the first discussions about this booklet concerned the idea to write about this theme from different angles. However, as this might have been a too narrow theme for participants/authors participating in the booklet, the theme was changed to be more “including”. I apply the theme on my experiences from higher education and the use of different Systems Thinking in different courses – mainly distance courses where students and teachers interact through ICT tools. Finally, the potential in Systems Thinking in research is exemplified.

1.1 The background

Systems approaches such as Team Syntegrity (Beer, 1994, Leonard, 2002) are used worldwide. Team Syntegrity for example, is a group process which facilitates team building, planning and innovation. The approach was developed by Stafford Beer and first introduced in his book “Beyond Dispute” in 1994. As much of Stafford Beer’s work, Team Syntegrity is characterized to be non-hierarchical in order to support and promote communication to be open and that synergy can be captured (Leonard, 2002). Conferences and groups are working with themes such as “Cybernetics of Crisis”, and “Syntegration”, in order to offer new ways of thinking about crisis and future transformation of organizations and societies. The approaches offers methods and tools for analyzing, diagnosing, understanding and redesigning as well as for communicating different kind of problematic situations.

I first got in touch with Systems Science or Systems Thinking in the beginning of the 1980s, when I read a description about a Systems Science program at the local university in Östersund. I was enrolled in the Systems Science program in January 1985. My first contact with Systems Science was an exercise in identifying J.R Miller’s 20 subsystems (Miller, 1991). The exercise aimed to apply Miller’s subsystem on a transatlantic liner. The identification of the subsystems supporting Material was not so difficult, but when the identification of information subsystem was in turn, it became more complicated. I had never thought about information in that way and a general knowledge about systems and organizations was necessary to solve the problem. Systems as hierarchies of subsystems – systems of systems – were also something totally new. It was a new way to look at and think about things.

It is not easy to introduce new students to Systems Science and the way of thinking this represents. As the semesters went on, we were introduced to some
more approaches and representatives belonging to different schools and directions. However, the fully potential was not understood until I became a Master student several years after the graduate education.

I finished my Bachelor of science on a Friday in January, 1988 and started to work as an assistant teacher on the following Monday. My introduction to become a teacher went smooth because during the first semester I only worked half-time, which meant that I had a lot of time to prepare the lessons, exercises, and assignments I would use. Between 1988 and 1999, I worked as a junior lecturer – mainly within courses close to systems development. The “big bang” or big change for me, according to me, when becoming a systems science disciple, happened in the middle of the 1990s, when I attended a master course called “Information technology”. The theme for this course varied from one year to another and in 1996, the theme was “Early warning”. It was not easy to find so much about the theme but concepts like “anticipation” and “anticipatory systems” (Rosen, 1985) were close. In this course, the students were expected to apply Early Warning Systems in some kind of practical example. I read what I could find about EWS, but I could not find any definition, so I had to define the concept myself. My final definition looked like this:

“The purpose of an Early Warning System is to make some kind of Target System aware of future events and processes, inside or outside the target System, that affect the Target System in a negative way”.

This was probably the first time I developed a definition on my own and that was a new experience. Afterwards, various definitions and their different meanings have been introduced and discussed in several courses. Often, students react on the fact that definitions differ and the reader must decide which one fits him or her, depending on several parameters such as aim and context. This is maybe one of the first experiences when students are exposed to the absence of “right or wrong” causing them not so little frustration.

Furthermore, most of the texts and discussions about early warning dealt with processes and how to handle and master undesired courses of events. Looking in the rear-view mirror, this should be close to “critical information” – the theme for our research group. However, not much was said about occurrences in the texts about early warning. From now on, we are well aware of the need for early warning with respect to earthquakes, volcanic eruptions, and so on. In these days, when we witness earthquakes and tsunamis in Japan, it feels even more urgent and highly topical.

Master courses were examined through writing scientific papers with final submissions to academic journals or acceptance to and preferably also participation in conferences. The background was of course to emulate the process to be close to scientific publication. This year, the attendees submitted abstracts to
1996 International Conference of the Swedish Operations Research Association (SORA). The conference was held in Luleå in October the same year.

I applied early warning on undesired occurrences such as bullying in compulsory school. The result was a model where I suggested routines for how to handle bullying in progress but also routines for avoidance of bullying in the future – preventive actions. Feed-forward and anticipation were some of the keywords used in the presentation. I read this paper a while ago, and it is still topical and of great interest. As late as this morning (July, 27th, 2011) bullying in the compulsory school was discussed on the radio due to some trials where local authorities in different municipalities had been sentenced to pay a fine to pupils who were victims of bullying. The conclusion of the radio programme was that tools and resources for how to handle this problem were missing.

For a master student, it was really encouraging and also a little bit “unreal” to see the “thinkers” one had read about and discussed for several years. We attended a workshop arranged by Stafford Beer and Allenna Leonard where we were supposed to “play/act” as a Viable System (Beer, 1972; 1974; 1979; 1985, Leonard, 1999). The participants in the workshop manned the Viable System Model which in this case represented a publishing house of academic literature where the main category of customers was students. VSM consists of five systems. System 1 is operations/implementations where the main activities in the organization take place (production). System 2 deals with coordination and is responsible for planning and coordinating plans and outcomes. System 3 is the control system which monitors sensors in System 1 in order to ensure internal homeostasis. System 4 is responsible for development/intelligence. This system is also responsible for contacts with the environment, guarding and could be understood as the organization’s main anticipatory system. System 4 has also access to the historic records so new information from the environment could be compared, ranged and analyzed with this information. This information is forwarded to System 5 which deals with overall direction and policy for the “whole” system/organization.

At the workshop, I was participating in System 1 – the printing office. Viability is warranted by recursivity in the systems. Therefore, the printing office also consisted of all 5 systems. Our task was to think upon and decide about future threats as increased occurrences of on-line books and how this phenomenon could influence and affect our survival.

To act and discuss VSM through the lenses of Beer and Leonard was indeed an adventure and maybe the most exciting single happening where I came in contact with Systems thinking in practice. At the following dinner, I happened to sit next to Stafford Beer and he was really an interesting and amusing dinner partner. This conference and the meeting – and mainly the workshop - with Stafford Beer and
Alenna Leonard, is probably the reason why I have chosen VSM in several of my later articles and also recommended the model to my students as a possible model for analyzing, diagnosing, and designing organizations.

The following headings present how different approaches from systems thinking have been used, both in courses I have been engaged in, and also in my own research. Much of the results would not have been as good without the use of these approaches.

2. **SYSTEMS THINKING IN EDUCATION – SOME SNAPSHOTS**

This section is divided into two sections – education at basic level (Bachelor) and education at advanced level (Master).

2.1. **Courses at basic level – some examples**

2.1.1 **Business Informatics, Management of business processes – Analyzing organizations in order to see new opportunities**

This course has had several precursors. The former department of Informatics at the university collaborated with Business economics and management, a discipline which also offered courses in our systems science program. The department where courses in "Business economics and management" were offered asked our discipline to tailor a course in “Informatics for business economists”. Later on, this course was further developed and “Business Informatics” was introduced to the students as a free-standing course which they could add to their exam. The course focused on business processes and how these should be analyzed, designed and maintained with the aid of ICT. A supplementary course was in demand and “Business Informatics, management of business processes” was developed. The latter course focuses more on management, innovation and visions in comparison with the first course, where more basic concepts concerning business informatics such as requirement analysis of business information systems, IT revision and IT security, were in focus. The course was developed by a team of teachers who had been involved in the former courses and with an interest in business informatics.

As one of the goals, of the syllabus states: “After accomplished course, the student should have deeper knowledge about models, principles and concepts for management and steering of business processes, the student should be able to identify, change and create new business processes based on cybernetic principles …” Cybernetics as a concept was introduced in the course and related to businesses and organizations. Hence, VSM as an example of a cybernetic model was introduced and also connected to one of the assignments of the course. Feedback, variation and systems of systems are
discussed in relation with business processes. The main processes and supporting processes are analyzed with the lens of VSM and the importance of feedback. Other important parts of the course is identification of threats and possibilities – business Intelligence for an organization, IT trends and their potential, business processes: identification, creation, evaluating and changing, creative techniques for identification and development of visions and work with organizational strategies, the concepts Quality in relation with business processes, networks and strategic alliances. The examination of the course is based on two former assignments. In the former assignments, the students had identified threats and possibilities in either an organization of their own choice which they were familiar with, or a fictitious organization. Furthermore, good examples of similar organizations had been identified and analyzed. With these former assignments as input, the students design or re-design the processes of the organization, based on the five systems in VSM. The course evaluations have been varying between very good experiences and new ways of thinking, until “difficult and not applicable on business processes”. The latter viewpoint is of course a defeat though the intention with cybernetics has failed with respect to potential and usefulness. This reaction is of course a challenge for further developing of the course.

2.1.2 Strategic Intranet development

This course is a result from the work with my PhD thesis. The name of my thesis was: “Designing Intranets for Viability – Approaching Organizational Empowerment and Participation” (Nyström, 2006). I have always had a great believe in democracy and empowering of people. The examples of Intranets studied during the work with the thesis were poor examples of empowering and also of participation in the process with the design of the Intranets. These facts encouraged and motivated me even more to come up with design principles supporting these matters. This was also in line with Beer and his mapping of VSM in the Chile case (Beer, 1974; Becket, 2003). While reading Andy Beckets story about the “Santiago dreaming”, it is obvious how much Beer has influenced and inspired researchers as Raul Espejo and Fernando Flores among others. Beckets begins: “When Pinochet’s military overthrew the Chilean government 30 years ago, they discovered a revolutionary communication system, a ‘socialist internet’ connecting the whole country” (Becket, 2003). This “socialist internet” was the “Cybersyn" which

25) Project Cybersyn was a Chilean attempt at real-time computer-controlled planned economy in the years 1970–1973. It was essentially a network of telex machines that linked factories with a single computer centre in Santiago, which controlled them using principles of cybernetics. (Wikipedia).
precursor probably was the early work of Simon Beer – the son of Stafford, who many years earlier, as a teenager, built a simple system consisting of bits of radios and pieces of pink and green cardboard - a series of electrical meters for measuring public opinion.

I used VSM as a model for diagnosing and design in the thesis and mapped the different systems of an Intranet as described in the Table below.

**Table 1** VSM mapped on an Intranet (Nyström, 2006).

<table>
<thead>
<tr>
<th>Function</th>
<th>Example Intranet and some design principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>System 1 Action/Operations or implementation</td>
<td>In order to remain viable, undesired occurrences or conditions in an operation must be measured, monitored and handed over to System 3. This can be done through some kind of Early Warning System (EWS). Conditions must also be compared with acceptable values. If production is spread geographically, communication links and different kinds of collaboration software should be established. Furthermore, the units must be autonomous so that viability is guaranteed. Policies, rules, states and different kinds of demands must be collected, presented and accessible for everyone (empowerment).</td>
</tr>
<tr>
<td>System 2 Coordination</td>
<td>A planning and coordinating system with both plans (budget) and outcomes/results concerning resources such as money, staff, equipment, etc. Planning meetings with support systems, such as calendars, planning systems, electronic whiteboards, schedules, etc. Everyone should have access to the planning systems.</td>
</tr>
</tbody>
</table>
System 4. Development/Intelligence

Supported by functions for collecting, presenting and analysing external data. It forwards analyzed information to System 3 and the policy level. The model of the entire company is represented in an Intranet. Research and development is supported by historical records and by functions for updating the state-of-the-art. A “Control centre” should be supported by electronic whiteboards and collaboration tools. Interactive functions where the environment can comment and react upon the organization. “Filters” which transform information from the environment to desirable representation (summary, aggregate) and vice versa. System 4 can be seen as the organization’s main anticipatory system.

Overall Direction/Policy, System 5

Supported by tools for presentation (visions, etc. of the environment). Different kinds of decision support systems. Regular meetings supported by planning systems and presentation/simulation tools.

The students participating in this course do not actually build any Intranet. They define important concepts in the course, relate environmental guards with Business Intelligence and System 4 in the VSM. Discussions about need for participation, empowering of users, strategies and policies, as well as more technical philosophical issues, are carried out in the course. The students test Intranet freeware, available online, and relate questions from the different lectures on the Intranets content functions. The course assignment consists of a planned study visit in an organization with a quite large Intranet, where the Intranet is investigated through interviews according to issues such as content, development process and user empowerment and participation. Finally, they document the result of the interviews and the analysis in a report. This course could probably be developed and enriched by the use of Boundary Critique (Simon, 1996) and boundary questions (Ulrich and Reynolds, 2010) where e.g. stakeholders and third parties in an Intranet could and should be critically discussed. The need for a more holistic view on Intranets was obvious in former studies so there is a need for a more comprehensive view of designing Intranets according to the effects of the organization, participation, power aspects, and not at least, influence. Systems Thinking could be a suitable tool for this.
2.2 Courses at advanced level – more examples

2.2.1 eCulture

The aim of this course should, to a high degree, encourage the students to react and reflect upon ICT in their daily life. The main content of the course considers human beings in socio-technical systems, historic, current and future ICT trends, theories and models for problemizing and explanation of ICT use due to social, cultural and psychological effects, ICT-based social groups, human and cultural effects of typical ICT use.

In one assignment, they should avoid some kind of ICT device for some days, and also discuss how it would work in a longer time perspective – a month or even longer. Several students choose their cellular phone in this exercise and discuss the experiences in the discussion board. It is amazing to see the discussions and the “oops” and “ahas” they got after this task. In later assignments, they are looking at the eSociety through the lenses of Herbert Simon (1996) and his Boundary Critique, Critical Systems Heuristics and the boundary questions by Werner Ulrich (Ulrich and Reynolds, 2010), as well as the multimodalities by Donald deRadt (2000) in order to raise new questions about stakeholders, third parties, different angles to look at things through modalities and so on. Finally, they plan and write an essay about a phenomenon of their own choice in the eSociety. During the autumn 2011, this course will, be further developed and connected to a course at postgraduate level. The intention is to implement interaction between the students at different levels. The students at the postgraduate level could act as tutors and sounding boards for master students. Interaction between courses was a “characteristic” for the former System Science program and it was also found to be a very good pedagogic step – learning-by-teaching-and-tutoring.

2.2.2 Communication in learning organizations

This course is developed and offered by BTH\textsuperscript{26} in the International Master program. Learning-by-doing and reflection in practice (Schön, 1983) is practiced both in the eCulture course and in this course. The students are for example identifying adequate internet links and formulating questions about the different sources. Furthermore, they refine these questions in the discussions with each other. To formulate “good” questions is not easy and the students gather valuable

\textsuperscript{26} ) Blekinge Tekniska Högskola, Blekinge Institute of Technology
experience when they practice this part of the course. There is a set of scientific articles related to “communication and learning” where they have to choose one of them and act as a reviewer for a fictive scientific journal, where they are supposed to review and grade one article. The articles discuss different angles of learning organizations, where for example Soft Systems Methodology (Checkland, 1981; 2000) could be used (Mirjamdotter, Somerville, 2008). The article by Mirjamdotter & Somerville discusses organizational change based on SSM in a North American university library. SSM is a systemic approach for tackling real-world problematic situations and it is a well-known and used model/method although it is an aid to structure complex problems and attacks them from several angles. Finally, they construct a “Handbook for learning organizations” using the “Synergy-4 Model” by Holmberg (2001) and characteristics from systems thinking (Senge 1990; 2006). The model by Holmberg aims to highlight the connections and intersections between Competence, Management, Organization and Technology. These intersections should of course be of great interest in learning organizations as they are due to continuous change. Of course, the outcome from the course varies, but some of the students produce excellent works where they discuss the model and the use of it. The main outcome is the analysis and design/re-design of the handbook for the chosen organization – fictitious or not – where they have to take several dimensions or spheres in the organization in account in order to fulfil the task.

3. SYSTEMS THINKING IN FUTURE EDUCATION

In my view, the use of systems thinking in courses at higher level is a wise choice. The students are offered methods and models which help them to attack what in some cases may be quite complex problems. Furthermore, they have a “tool box” for future situations where new ways of thinking is needed. The characteristics of how courses in informatics have been realized with a high degree of “learning-by-doing”, reflection in practice, and a tutor system where students in higher courses are tutoring students at lower levels are well worth keeping and developing further. Every situation – despite if it is e.g. a re-design of an information system, organizational change, design of inter-organizational systems spanning over country borders with the aim to support emergency management and planning in crisis – is unique. If the designer has the ability to act as a “system thinker”, then the outcome would probably be satisfactory. It is hard to prophesy about the future, but I am convinced that with a point of departure in a careful analysis of the situation at hand, methods and models based on Systems Thinking will be even more topical and relevant to use in the future. The need for such thinking in education is obvious.
It is probably not enough to use good tools for a good outcome in courses.
The “total believe” in what students can produce that Stig C Holmberg had, is
essential and a factor of success. Often, assignments were designed without a clue
how to solve complex problems: “If you show them (students) too closely how to
solve problems, then you are limiting them in their creativity” as Stig declared.
Accordingly, the general design of courses should be based on the motto:
“Students can, if they get the opportunity to show it”!

4. SYSTEMS THINKING IN RESEARCH

As mentioned before, I have used the ideas of Stafford Beer in several articles and
reports. The work of Stafford Beer, together with e.g. Werner Ulrich and his critical
heuristics, Soft Systems Methodology by Peter Checkland, and Synergy-4 by Stig C
Holmberg, are good examples of models/methods which could be used in several
contexts. According to our research theme – Critical Information - Systems
Thinking could be a fruitful way to tackle the different problems to be solved in
different contexts where Critical Information is present. The concept Critical
Information is to be found in the formulation of the vision, our research group in
Informatics at Campus Östersund has made: “We shall be acknowledged and lead
within design of systems for accessibility of critical information. This will be carried out
through applied research in close cooperation with stakeholders in order to create benefit.”
Furthermore, the concepts critical information is defined: “Critical information is
connected to a certain context at a certain time and a certain place. Critical information is
governed by needs and should have enough quality for the purpose where it shall be used.
Critical information might exist on several levels - individual, group, organization, and
society – which also should be connected to possible consequences. Critical information
must be made accessible for a certain target group – for those who need access to the
information so steps to minimize possible damages could be taken. In systems containing
and handling critical information, possibilities to aggregate data depending on different
needs, should exist. Finally, the connection to applied research implies that we, in
practice, together with different stakeholders design and create those systems.” Critical
Information could easily be related to Early Warning Systems, and this is today
probably more urgent than ever with respect to the terrifying bomb attack and
shooting in Oslo and on Utaya in Norway. The work in the Critical Information
research group has just started under the new theme and an exciting and hopefully
fruitful process is about to take form.

My last article – work in progress, is a presentation of collaboration between
researchers and former doctoral students of our department. Together, we
designed a model to support the work with guarding the environment in
organizations dealing with technical communication\textsuperscript{27}. The model is not limited to this type of organizations. It is a general model which could easily be used in other kinds of organizations. The idea with the model is to support continuously efforts to match of competence, organizational procedures, technology within an organization and visions/doctrines with demands from customers/purchasers who would like to buy services such as technical communication from the organization. In this case, the organizational memory is critical. This memory must be up-to-date and also complemented with information from the outside. We have used Stafford Beer’s VSM and Stig C Holmberg’s Synergy-4 when designing this model. I call this organizational function “\textit{Viable Intelligence}” to be compared with Business Intelligence, which leads the thoughts more to business economics and management.

5. \textbf{SUMMARY}

In summary, Systems Thinking could and should work as a good cocktail. One part should consist of Reflection, another of Criticism, and the third of Action. Blend them together carefully, and you will have a magic blend which could be used in several contexts. The society is becoming more and more complex and the challenges, threats and needs, demand new ways of thinking. It is important that this way of reflecting, criticizing and acting, is presented and made familiar for future decision makers early – at different levels during the school time. Systems Thinking could hopefully be one of the tools to handle future situations.

\textbf{REFERENCES}


\textsuperscript{27} “TC is the process of conveying technical information through writing, speech, and other mediums to a specific audience. Information is usable if the intended audience can perform an action or make a decision based on it (Johnson-Sheehan 7). Technical communicators often work collaboratively to create products (deliverables) for various media, including paper, video, and the Internet. Deliverables include online help user manuals, technical manuals, specifications, process and procedure manuals, reference cards, training, business papers and reports.” [http://en.wikipedia.org/wiki/Technical_communication, [accessed 2011-07-25]


Applying Synergy-4 in Informatics Research
– Some Reflections

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Abstract

In this article, we aim to scrutinize the ways Synergy-4 have been applied in informatics research so far and reflect upon the challenges the applying of Synergy-4 might bring along and how to deal with them. We have conducted a literature study in which the applying of Synergy-4 reported on in five different articles has been scrutinized. The main conclusion that can be drawn from the conducted study is that so far, Synergy-4 has not been applied to its full potential. This might be due to some of the lessons that we have learned during this study and when applying Synergy-4. One of these lessons is that the Synergy-4 model is easy to understand with its overlapping spheres, but the perceived simplicity of the model deludes the potential user to overlook the complexity of the model. It might be cumbersome to handle four different spheres and all the possible combinations between two, three or all four of them.

A second lesson learned is that Synergy-4 must be integrated already in the phase when the study is designed. It is not enough to depart from a holistic thinking inexplicitly or explicitly state that Synergy-4 is an illustration of the holistic thinking which is the philosophical base of the research if synergies are not explicitly discussed.

The third lesson learned is that it might be difficult to identify the synergies. Here, we call for some guidelines how to identify and measure the synergies.

Keywords: Informatics research, Police investigation, Synergy-4

1. INTRODUCTION

Research in informatics – at least in a Swedish context - has from the very beginning identified the intersection of information technology (IT) on the one hand and organizational and social issues of different kinds on the other as something of great importance. The very establishing of informatics (back in the old days labelled administrative data processing) as a subject in Sweden had this
focus as point of departure (Bansler, 1990). This focus also becomes visible in the different attempts to define informatics. For example, Dahlbom (1996) defines informatics as an artificial science with the intertwined complex of people and information technology as its subject matter, and Hedman et al. (2005) define informatics as a field concerned with the design of computer-supported information systems for individuals, groups, organizations, and nations performing purposeful activities. IT’s role in organizational development can thus be said to be in the very centre of informatics research. However, to investigate the development of an organization from an IT perspective is a very complex task and it requires more than just a shallow understanding of the symbiotic relation between the organization and its IT infrastructure. In order to support the process of understanding and developing organizations, so called multi-perspective approaches have been suggested. Examples on multi-perspective approaches can be found in Linstone (1984) and Linstone and Zhu (2000). However, this article focuses on a multi-perspective approach or model developed by Professor Stig Holmberg, namely the Synergy-4 model.

The Synergy-4 model is composed by four intersecting spheres: management (doctrine), organization and procedures, technology (technical infrastructure), and competence (human capital) (See figure 1)

![Figure 1](image_url)

**Figure 1.** An organization seen as a synergetic interplay between four spheres (Holmberg, 2001, p. 130)

The claim by professor Holmberg was that the intersecting spheres would illustrate that synergies were also important for the organization development. Synergies were also something that often was omitted and instead, the focus was often on one of the four spheres. (Holmberg, 2001) Relating the Synergy-4 model to
the discussion concerning the relation between the organization and IT, we argue that T in the model represents IT while the C, M and O represent the organization. But as illustrated in the model, they all are interrelated and affect one another.

Even though the model as such and the arguments and ideas constituting the base for it are rather straight forward, according to Holmberg (2001), applying a multi-perspective is very challenging. The aim of this article is to scrutinize the ways Synergy-4 have been applied in informatics research so far and reflect upon the challenges the applying of Synergy-4 might bring along and how to deal with them.

2. METHOD

The method for this article is to scrutinize the different ways – our own and others - Synergy-4 has been applied in informatics related research. To do this, we have conducted a literature study in which five different articles have been scrutinized. The following articles have been included:

1. Factors that improve traceability between information and process over time (Öberg, 2011).
2. Communication and information exchange among SMEs and their local environment (Asproth & Nyström, 2008)
3. Intranet use: a study of five Swedish organizations (Banck & Nyström 2005)
4. A holistic approach to competence development (Sundberg, 2001)
5. Success factors for police investigations in a hybrid environment: The Jämtland police authority case (Borglund, Persson Slumpi & Öberg, submitted)

From article 1-4 the use of synergy-4 will be synthesized and briefly presented in chapter 3, as well as used in the final analysis and discussion in this article. On the other hand, the article 5 will serve as:

a) In-depth example on how synergy-4 normally has been applied by presenting a case.
b) Analyze the applied use of synergy-4, aiming to identify shortcomings, and to present suggestions for improvement of how to use synergy-4 in future informatics research.

3. EXAMPLES OF WAYS SYNERGY-4 HAS BEEN APPLIED

Scrutinizing the ways Synergy-4 has been applied in informatics research, one can conclude that on an overarching level, so far it has been applied in line with the original intentions for researching organizations in order to understand and develop them in different ways (Asproth & Nyström, 2008: Banck & Nyström,
Apart from the above, one can also conclude that so far, Synergy-4 has been applied in rather different ways and has been given different importance in the research conducted, and thus it has had different impact on the organizations studied.

One of the ways Synergy-4 has been applied or has had impact on informatics research can be found in Asproth and Nyström (2008). In the research reported on in Asproth and Nyström’s article, Synergy-4 is part of the philosophical base of the research, e.g. expressed as a holistic approach. The Synergy-4 model is described to the reader and the relevance of considering all spheres when for example new technology is introduced into an organization is reflected upon. This reflection reappears in the result section, but discussions concerning the synergies between the different spheres in the model are difficult to identify.

A similar approach is found in Sundberg (2001). Again, Synergy-4 can be said to be a part of the philosophical base of the research, perhaps even more pronounced than in Asproth and Nyström. A more explicit use of the model can also be identified, but the focus is more or less on the competence sphere and again, discussions concerning synergies are difficult to identify.

In the two articles referred to above, Synergy-4 was part of the philosophical base but some more in-depth discussions concerning the synergies are difficult to identify. The role Synergy-4 plays is in other words rather modest.

Two examples of when Synergy-4 has been given a more prominent role can be found in Banck and Nyström (2005) and Öberg (2011). In Banck and Nyström (2005), Synergy-4 and the holistic approach is again the point of departure or the philosophical base. However, the Synergy-4 model is applied more as a whole in this research. For example, there are some reflections on the fact that in one of the organizations researched the four spheres where in balance with one another, while in other cases imbalances were identified. However, again, synergies are not discussed as such.

In Öberg (2011), Synergy-4 is also applied as a whole but in a slightly different way than in Banck and Nyström. In Öberg, Synergy-4 is applied as a method for analyzing the empirical material and structuring the presentation of the empirical material. Öberg even suggests some kind of weighting system for the different spheres, which can be viewed as a development of the model and its use. However, as was the case with the earlier research in which Synergy-4 was applied, the synergies between the spheres are not discussed in such an explicit way.

Summarizing the ways Synergy-4 has been applied so far illustrates that it has been used as an indication of the philosophical base, as a map for what to focus on, the relation between the different spheres, and as a way to structure empirical
material. However, so far, any thorough discussions concerning synergies between the spheres are more or less absent. It is obvious that the Synergy-4 model has some strengths and potentials, but there are also some difficulties and challenges. To be able to identify experienced strengths and potentials as well as the difficulties and challenges, we argue that an in-depth analysis of the application of Synergy-4 is required. The base for this in-depth analysis is research communicated in Borglund, Persson Slumpi & Öberg (Submitted) and is presented below.

4. IN-DEPTH ANALYSIS OF THE APPLICATION OF SYNERGY-4

The organization in focus of the research conducted by Borglund, Persson Slumpi and Öberg is the police authority in Jämtland County in Sweden. The aim with the research as communicated in the article is to identify both success factors and needs of improvement in police work related to a prostitution investigation that became very successful. In Borglund, Persson Slumpi & Öberg (Submitted) it is claimed that Synergy-4 is applied in order to identify the success factors as well as the needs of improvement. It is this application of Synergy-4 that is scrutinized here.

The structure of this section is as follows: in 4.1, the background and the context of the research case, i.e. the police investigation, in which the synergy-4 model was applied, is presented. In 4.1, the research method used to collect the empirical data for this research case is also presented. In 4.2, the collected raw empirical data is presented, followed by a Synergy-4 analysis of the investigation presented in 4.3.

4.1 THE UNDERLYING CONTEXT OF THE RESEARCH CASE

The police authority in Jämtland County is the smallest regarding to the number of police officers employed (220 police officers). It operates in the west part of mid-Sweden in an area that covers 12% of the total area of Sweden which is populated by only 1.5% of the Swedish population. This small police authority was in charge of what later became the biggest prostitution investigation in Sweden ever. Four police officers in cooperation with the prosecutor succeeded in reporting one “pimp” and 427 buyers of sexual services living all over of Sweden. The achievement of this small group should be compared to the less than 200 men that are reported each year for violating the law against buying of sexual services in Sweden in total (Uutredningen om utvärdering av förbudet mot köp av sexuell tjänst, 2010).

The context of the achievement of reporting more than twice as many buyers is that since 1999, it is not illegal to sell sexual services in Sweden; but buying these services are prohibited (6th Chapter, 11th section “Swedish Penal Code,” 1962). The
argument for this has been that the women – there are mostly women being prostitutes – often have not chosen to become prostitutes. They have been forced due to different circumstances to sell the only asset they have, their body. Criminalizing the selling of sexual services would hence make the women doubly victimized. However, the Swedish police and the prosecutors have been criticized for being inefficient in identifying, reporting and bringing buyers of sexual services into justice (Utredningen om utvärdering av förbudet mot köp av sexuell tjänst, 2010). Hence, this achievement is astonishing in itself. Our interest in this case was however not triggered by the number of buyers reported. Instead, it was that at a press conference, when the result of the investigation was presented, digital footprints such as text messages (SMS), e-mail, and traces left from activities on Internet were claimed to have played a prominent role in the process of delivering a solid investigation. Even though more traditional methods had been applied in the investigation, such as telephone tapping and traditional surveillance operations, digital footprints were still of great importance. In other words, the traditional focus of informatics as an intersection between organization and IT was what triggered this research in the first place. However, the impact IT had on this investigation needs to be further presented, which is done below.

The police investigation has been investigated by combining a variety of empirical sources like interviews, newspaper articles, broadcasted press conferences; one of the researchers in this study even has experiences as a police officer. This is in line with how Yin (2003) argues that a case study can be conducted. In this particular article, we mainly focus on the empirical material collected through interviews. This is because it is the primarily empirical source, but also, as Walsham (1995) argues, interviews is the best way to access the interpretations of the participants taking part in the event.

Interviews were conducted with several members of the group investigating the crimes. But because the group investigating the crimes was rather small – four police officers and one prosecutor – only three interviews were conducted. Despite the small number of interviews, we argue that a good first understanding of the investigation has been achieved. After all, interviewing three police officers corresponds to interviewing 75% of the police officers engaged in the investigation at the police authority responsible for the investigation. There were other police officers engaged in the investigation at other police authorities as well, but they were not responsible for the investigation.

The three interviews reported on here were the very first ones in this research project; hence, they were very open in character. The aim was to gain a first understanding of the investigation as a whole, hence focusing on methods used, the distribution of roles and work, and the role IT played in the investigation. To
gain this understanding, the following questions were presented to the interviewees:

1. How did it all start (the sex purchase investigation)?
2. How was the investigation conducted?
3. What roles are there in an investigation and how is work distributed between the different roles?
4. Is there some basic methodology to depart from?
5. What are the reasons for the success of the investigation according to your experiences?
6. Why did the police invest so many resources into this investigation?
7. How has information been communicated internally and externally?
8. How has IT been used both in the collection of evidence and to support in the investigation?

All of the interviews were conducted at the 27th of September 2010 and they were conducted in public spaces in the police house in Östersund. They were all recorded.

4.2 The police investigation in close up

In large parts, the following in-depth presentation of the case can also be found in Borglund, Persson Slumpi and Öberg (Submitted; 2010).

Even though the police authority of Jämtland County was in charge of the investigation, it was not initiated by this authority. Instead, it was initiated by an analyst at one of the regional intelligence units. The analyst who initiated the investigation was employed in a special project to increase the knowledge about activities related to prostitution in the northern counties in Sweden. As part of this project, one task was to scan the Internet for web pages and web forums at which sexual services more or less openly were offered. During this scan, the analysts noticed that there were a couple of women that seemed to actively work as prostitutes mostly in the mid-Sweden region (Västernorrland County and Jämtland County). The women seemed to be like prostitute nomads, who moved their business around. Through the surveillance, the digital footprints from the women’s activities on the Internet could be mapped into a cluster of activities with the centre in Västernorrland County. Through the digital footprints left on the Internet, the intelligence analyst could map patterns of how the girls moved in the north of Sweden, and how they communicated their presence in advance. The police authority in Jämtland was contacted and informed that one of the women planned a trip to Östersund (the largest city in Jämtland), and that she had offered sexual services on her advertisements on the Internet. This information triggered the police authority of Jämtland to initiate a surveillance operation. During this operation, the police managed to identify not only the woman but also a man that
seemed to be controlling her business and who had reserved the hotel room for the woman in which she was supposed to meet the buyers. This way, they could start an official criminal investigation about gross procuring that later resulted in 427 men being reported to have bought sexual services.

One success factor in more or less any criminal investigation also in this one is to have well-documented evidences of the crime that the public prosecutor can use for the court proceedings later. With the identity of the women that visited Östersund identified, the police could continue to follow her as well as her activities on the Internet, and capture her digital footprints. Through this process, they succeeded to get a permit to set up a phone tapping of the “pimp”. Through telephone tapping, and Internet surveillance, the police identified another four women controlled by the same “pimp”. The “pimp” used Internet but also the teletext (Text TV) as the forum where he advertised the services the five women provided. There exist several sites for this purpose, and the communication and advertisement was done very open. When the police collected the evidence, it was important to document what happened in a chronological order. For example, when there was an advertisement on the Internet, the police needed to take a screen shot of the web page, record it and follow up that information with recordings from the telephone tapping, pictures of persons entering the hotel where one of the five women stayed. The goal was to gather a chain of digital footprints of activities that could act as evidence of what the “pimp” had done and the persons buying sexual services had done. It was extremely important to make sure that this chain of evidence could not be broken and questioned by e.g. an attorney. Until the police had collected as much evidence needed according to the public prosecutor, the police worked like this: a) Follow the information put on Internet and teletext, try to see patterns. b) Compare this information with telephone tapping, identify patterns. c) Carry out real surveillance, document meetings between suspected buyer of sexual service and the women that were suspected to provide the services.

The intelligence analyst that initiated the investigation, together with the police, recorded as many activities possible on the web pages where the five women announced their services, with an aim to collect as much evidence for the investigation as possible to show the extent of the prostitution business. When the public prosecutor had collected enough evidence, she decided that it was time for an arrest. The police arrested the male “pimp” for gross procuring.

Once the “pimp” was arrested, the public prosecutor decided that the police should aim to gather more evidence so that the full extent of the prostitution business could be presented at court and used in the prosecuting of the “pimp”. The public prosecutor also decided that the aim was to convict as many buyers of sexual services as possible. The search for evidence went six month back in time.
One important source of digital footprints was the usage of mobile telephone. 16,000 records of SMS or calls between potential buyers and in this case, one of the five women was analyzed during the police investigation. Parallel to this analysis of digital footprints, a more traditional police investigation took place, where involved persons were interviewed. Other digital evidence was also collected, when the police could follow the “pimps” activities on various Internet sites and online auctions, where he bought train tickets for the women. All 427 men that had been reported for buying sexual service at least on one occasion were interviewed and during the interview the collected evidence was presented to them. If a buyer confessed, he was offered to pay the fine without court proceeding.

4.3 The Synergy-4 analysis of the police investigation

The empirical material is claimed to be analyzed by applying Synergy-4 as a lens by Borglund, Persson Slumpi and Öberg (submitted). However, before the analysis, the authors’ view of the different spheres is developed. They define the different spheres as follows:

“Management, we argue, is the ways the investigation and the group conducting the investigation have been supported by the different levels of management through decisions and actions. This means that it is not one level of management but several. Organization and procedures is the actual organizing and conduct of the investigation. The technology in focus is IT, both as source of digital footprints and as a support in the investigation. Finally, competence is the skills and knowledge the group investigating the crime has or needs to acquire.” Borglund, Persson Slumpi & Öberg, p. 4, Submitted

After having defined their views of the different spheres, a Synergy-4 analysis structured by the different spheres in model follows. This presentation in large parts corresponds to the one found in Borglund, Persson Slumpi & Öberg (Submitted) and is recaptured here. However, some alterations have been made but only with the aim to improve the presentation and not to change the content.

Technology

For researchers with a base in informatics, technology is a natural place to depart. In this case, it was also the main reason that we got interested in the case in the first place. In fact, digital footprints generated by different types of IT artefacts were what triggered the whole investigation to start with. Drawing on the deeper introduction of the investigation presented above, IT can be said to play three different roles. Firstly, IT generated digital footprints that could be followed in the investigation. Secondly, IT was used as tool for analyzing the information gathered. Thirdly and finally, IT was used for communication both internally and externally by the group of police officers.
Starting with the digital footprints identified by the analyst, they initially occurred on sex websites and on the teletext of one TV-channel. This was the main communication channel used to reach potential buyers. However, also other types of IT artefacts were used in the communication between the women/“pimp” and the potential buyers. The most comprehensive set of digital footprints originates from communication between the different parties by using mobile phones. All in all 16,000 unique digital footprints - text massages, phone calls, etc. - or so called events were detected that indicated potentially the closing of an agreement for buying sexual services. This set of events conveys information like what different numbers that were engaged in a communication, when this communication took place and where in Sweden the different parties were at that particular point in time when the communication took place. What must be recognized though, is that these 16,000 events were not all the events registered. Some events were excluded because it was not possible to clearly detect who had made the call as the phone was registered on a company and not an individual. Phones registered on 60 to 80 different companies had been used in the communication with the provider of the sexual services, but these were not included in the 16,000 events.

The method for detecting these events was that the police requested lists from the phone companies concerning all communication to and from that particular number. Later on in the investigation, the phones the women were using were confiscated and by scanning what other numbers had also been related to the phones unique IMEI-number and additional numbers could also be detected. The confiscation of phones also gave access to the phonebooks, in which several regulars under nicknames like “Stupid man” or “Likes tits” were identified. Being enrolled into the phonebook strengthened the suspicions towards these men and made it difficult for them to assert that they had only called the wrong number.

Apart from the above mentioned digital footprints, also footprints from transactions on the e-commerce site Tradera28 were identified. At Tradera everything from computers to travels are offered and in this case it was train tickets to different cities in Sweden that was purchased. Finally, e-mails sent to and from the women were also a potential generator of digital footprints, because in some cases the contact information was a Hotmail account. However, in this particular case, no e-mails were detected and hence used as evidence in the investigation.

The second role IT played was in the police officers’ work when analyzing all of the information gathered, but perhaps even more so in creating relations between different information sets. One part of this process was to identify the potential buyers. Some of them were caught by regular surveillance of apartments or hotel

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rooms in which the police knew that the sexual service would be purchased. In other cases, the purchasers were identified through the phone number. The police simply used their own registers and telephone number services provided on the web, like Eniro29, to identify these men. In the process of linking different information sources, external special software used in police work practice were used. In the process of linking information together, the police used for example information from the phone lists that was manually pasted into Excel sheets. Then a macro was applied that translated the prostitutes and the buyers into icons.

Thirdly, IT played the role as means for communication mostly with managers, the public prosecutor, the court, but also with media. To communicate with the public prosecutor and different managers, e-mail as well as calls and SMS were used. IT was also used in the design of presentations of the results of the investigation. However, one problem in this process was that the lists from different phone companies had different structures. This forced the police to manually reorganize several thousand events so they were presented in the same way.

Management

Turning to the sphere of management, the support from the different levels of management for this investigation was indicated in several different ways. One of the most visible supports for the investigation was from the group leader. Her job has been to manage the investigation and spur the investigation group. But a considerable amount of time has also been spent on promoting the relevance and the importance of the investigation to the superior, and showing the progress the group is making. This has been of great importance because in this case, the group leader has no authority to make decisions concerning resources or what to focus investigations on. The budget responsibility is on a higher level and to get the investigation approved, she describes it as a lobbying process towards the superiors. Part of this lobbying process is to keep the superiors well-informed during the whole process. To do this in the best way possible, the group leader has adapted her communication strategies depending on which superior she communicates with. In some cases, the superior wants a brief summary in an e-mail and in other cases an oral report is what is favoured. The important thing though is that all superiors have the same information.

Turning to management levels higher up in the hierarchy of the organization, managers on these levels have shown their support for the investigation by approving the investigation and assigning resources to it. For some time during the

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investment, the group did not work with anything else than the investigation in focus for this article.

**Organization and procedures**

The organization of the investigation can best be described as close cooperation between different actors important for the investigation. Firstly, it has been a close collaboration within the group investigating the crimes. Traditionally, there are two different groups working in an investigation. One group is the one that so to say creates the base for the investigation by collecting evidence, identifying perpetrators, etc., and a second group is interrogating perpetrators, interviewing victims and witnesses. In this particular investigation, these two groups more or less worked parallel with one another, at least in the later part of the investigation. Within the investigation group, they also communicated more or less on a daily basis, for example what the most recent developments in the investigation were and what the expected developments were.

The public prosecutor also played an important role and also worked close with the investigation group. The group leader estimates that she has been in contact with the public prosecutor several times a week in person, by phone calls or SMS.

The procedures used are a mix of traditional police investigations and the identification of digital footprints that requires somewhat new approaches. To the traditional procedures we count surveillance, interrogations with suspects, interviewing victims and witnesses. To the new procedures the gathering and analysis of digital traces like websites, e-mail, SMS, etc. can be counted.

**Competence**

The major competence of the police force of course lies in traditional police work: surveillance operations, interrogating suspects, interviewing victims and witnesses, etc. In this investigation, all these competences and others have come into use. Because this type of crime had not been investigated before by the local police authority in Jämtland, they needed to get prepared by getting up to date concerning methods, etc. This was done by for example contacting the Street prostitution group in Stockholm.

A competence that was crucial for the success was that of communicating with different actors the way they wanted to. This was to a large extent the job of the group leader. In some cases, they wanted an e-mail once every other week; others wanted an oral account of the status of the investigation. Related to this is how to structure the information to get the best result.

Another competence aspect in this case was that throughout the entire police investigation, the police officers with best competence to solve upcoming problems
were assigned to solve the problem. Even in a small group as in this case, not all had the same skills.

In the process, an increased competence concerning the impact IT might have and the lack of proper tools for effectively investigating crimes with this kind of information sources was developed.

5. SCRUTINIZING THE SYNERGY-4 ANALYSIS

The above Synergy-4 analysis could be scrutinized by applying the different approaches identified earlier: philosophical base, a map for what to focus on, and the relation between the different spheres, as a way to structure empirical material. To these approaches, also discussions concerning synergies between the different spheres should be added.

When designing and initiating the above presented research case study, Synergy-4 was not in our immediate attention. Hence, one cannot say that Synergy-4 was a part of our philosophical base, when the design of the research started. But scrutinizing the questions that were formulated for the interviews they could most definitely be mapped to the different spheres of the Synergy-4 model. The questions that were in focus in the interviews were the following:

1. How did it all start (the sex purchase investigation)?
2. How was the investigation conducted?
3. What roles are there in an investigation and how is work distributed between the different roles?
4. Is there some basic methodology to depart from?
5. What are the reasons for the success of the investigation according to your experiences?
6. Why did the police invest considerable resources into this investigation?
7. How has information been communicated internally and externally?
8. How has IT been used both in the collection of evidence and as support in the investigation?

Firstly, in informatics, IT is more or less always in the forefront. In this case it is illustrated by question 8, in which IT is solely in focus. This means that the technology sphere of the Synergy-4 model is addressed.

Turning to the sphere of organization and procedures, it is addressed in questions 2, 3, 4 and 7. In these questions the issues of how the work in the investigation is conducted, what roles could be identified in the investigation and what ways the work is distributed between these roles, if there are some particular work method that the investigation departs from, and the different communication patterns are addressed.
Question 2 and 4 can also, along with question 5, be related to the competence sphere. The competence of the interviewed police officers should be visible in the way they have conducted the investigation and if there was some specific method used. Being able to identify success factors also draws the attention to the competence of the individual police officer.

The management sphere is most explicitly addressed in question 6. The group of police officers investigating the crimes in focus did not have any authority to decide what type of investigations to conduct. This was decided by managers higher up in the organization.

It is really only question 1 that cannot be related to the different spheres. On the other hand, this question is as such very wide and opens up for potential reflections and discussions concerning all the spheres.

The conclusion of this is that the ideas behind Synergy-4 are something that seems to be part of the very core of informatics research. Without intentionally departing from Synergy-4 when we designed the study and formulated the questions, they still seem to embrace the holistic thinking that Synergy-4 is funded upon. Synergy-4 could hence be a natural point of departure for researchers within informatics. However, the questions formulated do not really address the synergies as such which is a clear indication that Synergy-4 was not the point of departure for this study in the first place.

In the research case study presented above, Synergy-4 has also been used as a combination of a map and a way to structure the empirical material. By having the four spheres, the discussions are centred on four different themes. These themes, e.g. the four spheres, are then used as a way of structuring the presentation of the empirical material. There are, however, few if any discussions concerning the relations between the different spheres or concerning any synergies between spheres. This is also in line with the way Synergy-4 was applied in the four other research articles presented in chapter 3.

6. LESSONS LEARNED

After having scrutinized both others and our own application of Synergy-4, we can conclude that there are a lot of lessons to be learned. One of these lessons, which Holmberg (2001) already has indicated, is that applying a multi-perspective is difficult. For example, the Synergy-4 model is easy to understand with its overlapping spheres, but the perceived simplicity of the model deludes the potential user to overlook the complexity of the model. It might be cumbersome to handle four different spheres and all the possible combinations between two, three or all four of them. An indication of this might be that we so far we have not seen a really good attempt to discuss synergies between the different spheres in the Synergy-4 model.
A second lesson we have learned is that Synergy-4 must be integrated already in the phase when the study is designed. It is not enough to depart from a holistic thinking in inexplicitly or explicitly state that Synergy-4 is an illustration of the holistic thinking which is the philosophical base of the research if synergies are not explicitly discussed. Hence, in order to apply Synergy-4, research should be designed to explicitly try to identify these synergies.

The third lesson learned is that it might generally be difficult to identify the synergies. Here, we call for some guidelines how to identify and measure the synergies. So far, most of the research in which Synergy-4 has been applied has been qualitative. Perhaps a quantitative approach would be more suitable. In either case, a development of guidelines for ways to approach the synergies is welcome.

We see great potential in the Synergy-4 model, but its application must be further developed so that the complexity of the model is recognized from the very beginning, but also that the complexity is dealt with by different guidelines.

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The Emergence of Service Oriented Architecture from a Business Perspective

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“…SERVICES ARE THUS COGNAC ON A TAP” (RESEARCHER OF DIRECT COMMUNICATION, 2010)

ABSTRACT

This chapter describes and discusses the emergence of Service Oriented Architecture (SOA) from a business perspective. This view is rarely discussed in literature: the technical view is mostly talked about. The study is done as a qualitative, hermeneutical and inductive research. The different levels are seen as meta, macro and micro levels in the organization. Included in these levels are different domains; meta contains business vision and strategy. Macro has three domains; the domain of shared principles, the domain of decision process & makers and the domain of business process & development. Micro contains the service–based environment. Conclusions drawn are that ownership, communication and competence are factors that the different levels in the organization need to take into consideration.

The content of this article has its origin in a Master Thesis with the same heading as above, written at the IT-University Gothenburg in 2011. One of the authors is now a PhD student at Mid Sweden University and has been asked to contribute in this booklet with an extended abstract from the thesis. The booklet is to be published to honour Professor Stig C Holmberg, and I am grateful to have been asked to make this contribution in an early stage of my academic carrier.

Keywords: service oriented architecture, business development, business processes

1. INTRODUCTION

Organizations of today, whether they are privately held or public, act in a demanding context with stakeholders and requirements that continually change (Burnes, 2004). These demands are like new quality requirements, more
information to be sent to an authority or a new competitor. Dahlbom (2003) describes the evolution of a growing nomad society, with more volatile relations between the consumer and the provider. This society sets new requirements to connections, both in terms of time and quality. Benefit needs to be seen at once and also be measurable right away (Lundberg, 2009).

1.2 The background

Packaged services can be an important ingredient for organizations to meet the new customer demands (Marks & Bell, 2006). Standardized services need to contain a rich flow of information of good quality. For the providing organization, a new architecture must be built, Service Oriented Architecture (SOA). The architecture provides services which are exclusive for the customer and easy to maintain for the provider. Organizational information is a business asset (Magoulas & Pessi, 1998).

Technical literature about SOA is easy to find and also some literature with a business perspective. Unfortunately, literature with a business perspective is written by authors with a technical background which influences the content.

From the initial discussion, the thesis has the purpose of providing management, at different levels, with factors to be considered when implementing a SOA in an organization. The research question is:

From a business perspective, which factors need to be addressed at an emergence of a Service oriented Architecture?

2. THEORETICAL FRAMING

This section is divided into four sections – SOA, Benefit Management, decision levels and SOA governance model. The purpose of the different sections is to provide a theoretical framing for the study.

2.1 Service Oriented Architecture

Fundamental concepts for SOA are services and architecture. A service can be seen as a business function (Marks & Bell, 2006), where a process is delivered repeatedly to the users of the service. Marks and Bell claim that the service consists of one business part and one IT part. Kanchanavipu (2008) says that business service should use the organization’s processes and assets, all in order to satisfy the consumer.

Architecture can be seen as:

The fundamental organization of a system, embodied in its component, their relationships to each other and the environment, and the principles governing its design and evolution. (Opengroup, 2011)
Different views of an organizational architecture are needed, all in order to keep the communication on the right level (Erl, 2009). One concept in the architectural areas is the design, which describes the components to use (Opengroup, 2011).

2.2 Benefit Management

The investment, which the new architecture actually is, needs to be evaluated and communicated. In the case of communication, the benefit matrix and benefit map are good models (Lundberg, 2009). In the model, benefit and resource usage can be seen. In order to benefit from the IT investment, knowledge and management must be in alignment with the business (Ward and Daniel, 2006). One model that can be used for benefit management is Ward and Daniel’s (2006) Benefit Management (BM). This model starts from the business strategy and gives the investment’s areas that are most beneficial, named the driving forces. From the driving forces, in a Benefit Dependence Network (Ward & Daniel, 2006), business benefit gives the appropriate business changes. The IS/IT changes needed are then originated from the business changes, all in order to fulfil the business strategy. Ward and Daniel point out the importance of change owners with responsibility and authority to drive needed changes forward.

2.2 Decision levels

To answer the study’s sub question, different decision levels are introduced, meta, macro and micro (Hoffman, 1988). The meta level is described as the level where the vocabulary is created and the level where the ideal information system environment is created. Hoffman implies that the macro level describes strategic and tactical plans to achieve business’ goals with IT. Micro is the operational level where the guidelines on a detailed level are created.

2.3 SOA governance model

As indicated above, SOA with a business perspective is not easy to find. The SOA model below, figure 1, originates from Kanchanavipu’s (2008) SOA model with angle decision processes and decision makers.
The meta level consists of **domain of business vision and strategy**, where the business mission, the uniqueness of the particular organization, should be reflected (David, 1989). The management at meta level needs to develop and communicate the vision and strategy throughout the organization.

The macro level contains three domains; **the domain of shared principles, the domain of decision process & makers and the domain of business process & development**. The **Domain of Shared principles** is composed of shared values, i.e. policies, standards and goal descriptions. Within this domain roles and responsibilities, i.e. the organizational culture is described. The next domain, **decision process and makers**, says how the decision process is organized and who can make the decisions (Davenport et al., 1992). The third domain at macro level is the **domain of business processes and development**, where the processes and their definitions belong. The influence any business process change has on the internal organization or external influence is included in this domain.

The micro level, the operational level or the **service-based environment** has three parts: service provider, service consumer and service broker (Kanchanavipu, 2008). The interactions between the parts are the base for the services and can be described as visibility, interaction and real world effect (MacKenzie et al., 2006).

### 3. Method

The study, performed as a Master Thesis at the IT-university in Gothenburg, in cooperation with the Viktoria Institute, has its main empirical base from Trafikverket (TV) in Borlänge. TV is a state agency, one of their responsibilities is the long-term infrastructure plans of building, operating and maintaining the railroads in Sweden.
3.1 Scientific approach

In order to answer the study’s research question (RQ), a qualitative research method was used. Berg (2009) describes this as a method which seeks to answer questions by various social settings and the individuals who occupy these settings. The RQ links human and technical behaviour, interpreted in a qualitative research process, called hermeneutical research process (Backman, 1998). Backman refers to a comparison between empirical base and the theoretical base as an inductive approach.

3.2 Data collection and analysis

One iterative step in the qualitative research method is literature review. The review has been made through search engines on the Internet and also by using literature from the IT Management program, IT University Gothenburg.

Empirical data were collected at four different interview sets, with fourteen different respondents. They represented TV within different IT and managerial positions (two interview sets), consultants from IT industry specialized within SOA and the last set of respondents came from the university. All the interviews were semi-structured with interview questions prepared in advance.

A data analysis was made from the empirical material, using different categories and sub themes from the theoretical material. The foundation of the study’s structure was prepared in a summarized form.

4. EMPIRICAL FRAMING

The study’s empirical material is presented from the three different levels; meta, macro and micro. The general empirical material contains descriptions of statements by the different respondents.

4.1 Meta level

Respondents are interested in discussing service development with the top management, since they have the official instruments, budget and organizational strategic decisions, at their disposal. Very seldom, services are mentioned in the business idea, and several respondents express that the top management does not have any knowledge about SOA as a concept. One reason for this can be that the concept is too abstract and difficult to overview. In industries with a long-term relationship between the consumer and provider, business ideas can express services in the form of service packages.

Respondents say that the IT strategy has to originate from the business strategy. The responsible role for this is the Chief Information Officer, CIO, or similar
official. In order to make communication easy, the strategies need to be short and powerful. To introduce a service oriented approach in the organization means to change from a functional oriented to a service oriented organization with strict defined domains. Otherwise, sub optimization can easily arise. Even though the organization uses SOA, pressure can be too high on the IT project to deliver according to project goal and not within the SOA frame. Several respondents say that ownership needs to be set for each service. The ownership can be both strategic and operational.

4.2 Macro level

To govern integrations at macro-level, an Integration Competence Center, ICC, is a useful to have. Members of ICC can justify development of new services in the right manner; communicate the benefit of developing services to IT projects and purchase services according to approved policies. Other roles mentioned by the respondents are different kind of architects, e.g. enterprise, solution and business. They all need to participate and decide upon solutions.

The bases for services are business processes, which need to be visualized in cooperation between IT and business sides. This work starts at an overall level and also includes stringent and clear definitions of the different processes. One proposed method is OASIS (Jones, 2005) where the services are broken down functionally. The top-down view will easier give benefit for the organization and prevent sub-optimization.

Most of the respondents say that nowadays, integrations are commonly used instead of spaghetti architecture. Many organizations talk about services, but they are rarely developed. Communicating the organizational benefit of using services is still a problem.

A service catalogue is a useful way to document services. This catalogue can be used by both the provider and the consumer. Unfortunately, the services are seldom documented in a good manner. Everybody understands the benefit of true and updated documentation, but this is seldom prioritized. A generally held service catalogue can prevent new, almost similar services from being developed.

At the start of service development, all the required competence needs to be put together to get a rich picture and decision plan. Several respondents mention the “Good Example” as a starting point for developing services. The “Good Example” consists of already existing services, developed independently. Competent actors within the organization can make incremental service development, often starting in the IT organization or business people familiar with external stakeholders.
4.2 Micro level

According to several respondents, the consumer’s requirement competence is seldom good enough. This way, the provider is given great control. If there is a service catalogue to order from, it is often written too technically and therefore not understandable for the consumer.

One driving force to develop services was to bring order to the IT department and by doing so; IT architecture came as an additional benefit. Another driving force mentioned was expected increase of customers and end-users. Before using services, the IT test process was too complex and changes created problems in other systems.

In the future, there will be different kinds of customers who use services, premium consumers and free-riders. Premium consumers will have fast access to services and information. Free-riders will be seen as undefined end-points to the provider and they will have lower access to service and information.

One respondent expresses that in the beginning, services were web services and technical solutions, but nowadays business orientation is also included. The respondent continues to discuss the lack of business visionaries, just to create new services.

5. DISCUSSION

This chapter will discuss theory and empirical data. The discussion will be held on the different levels, meta, macro and micro.

5.1 Meta level

The organization’s overall document is the business idea (David, 1989). The idea must be unique and must give an overall understanding for its context and purpose. Empirical data show that the business idea seldom mentions service as a concept and simply following old footsteps is easier than changing the existing business idea. Business and IT strategies are created from the business idea, and they should be aligned with each other (Henderson & Venkatraman, 1993). Strategies will be used for communication regarding the goals (Ward & Daniel, 2006). For them to be relevant, persons with the right competence need to participate in their development (Marks & Bell, 2006). The study shows that often different kinds of competences are missing, especially in order to create service strategies. One problem with a low number of participants is that energy, new ideas and innovation will be missed.

On a meta level, managers need to assign owners of the services. Empirical data imply that ownership gives the best benefit at a central level: ownership appointed
at a lower level can create redundant services. On the business side, there must be process-owners, both for internal and external processes (Sörqvist, 2004).

5.2 Macro level

The empirical material shows that one factor of success is communication and that linguistics needs to be stringent and adjusted to the target group. This implies that technical language is unsuitable when discussing with the organisation’s business side. Marks and Bell (2006) indicate that SOA policies must cover the entire lifecycle. Furthermore, they say that documentation needs to be agreed upon, in order to make policies a natural part of SOA. Every policy must clarify ownership, responsibility and limitations. The individual service can be described in a service catalogue, in a single and unique way. Several respondents say that documentation is rarely collected, due to de-prioritization in single IT projects. These de-prioritizations, done from management side, can delay implementation of useful services.

Both theoretical pictures and empirical material show that implementation needs to be done in small, incremental steps (Sörqvist, 2004). This gives little interruption in operations and also successful services as examples, which the respondents called the “Good example”. Business processes will be broken down from an overall view and benefit is easier to discover at an early stage (Jones, 2005; Sörqvist, 2004).

Decision process within SOA at macro level refers to a more detailed strategic process. Development needs to be held together, in order to keep redundancy low. Participants in the decision process must come from both the business and the IT side, in order to keep the competence level high and mixed and also have a good communication further on in the organization. Checkpoints for SOA development need to be on a high level in order to make the decision as beneficial as possible for the whole organization. Communication from macro level regarding SOA implementation must be reliable and force the implementation, at micro level, to use SOA policies (Marks & Bell, 2006).

5.3 Micro level

The operational micro level comprises three parts; consumer, provider and broker. Their responsibilities limitations need to be defined (Kanchanavipu, 2008). In practice, this is often done in a Service Level Agreement (SLA). One outcome of a SLA is that all parts will gain new competence from each other; i.e. the provider will know more about the consumer.

The change leader must be managed from a top-down perspective (Marks & Bell, 2006). They continue to discuss the roles that the change leader needs to
cooperate with, e.g. the business architect or the solution architect. A follow-up needs to be communicated to the steering-group and other stakeholders by the change manager. This can be done in the form of the BDN (Ward & Daniel, 2006) and the study shows that communication has to be stringent and generally documented. It further implies that service development needs to start, and not include the heritage. Ward and Peppard (2002) say that benefit needs to be expressed for all IT investments, and this gives that the inheritance should be left untouched. Iterative implementation of services, according to Xue et al. (2008) and several respondents, with fast respond from the consumer, gives the best result.

One respondent clearly expresses the knowledge demand for visionaries with domain knowledge, within the organization’s industry, when creating services. The domain knowledge, in combination with technical competence, makes the services implemented according to decided design patterns and also a good communication with the business side.

As discussed before, the business side has to attend the implementation of a service based concept. But it can be good idea to let the IT department start using services in order to have a structured and controlled way of dealing with the IT infrastructure. This is a standardized way of storing and delivering information (Newman & Friedman, 2005).

The service catalogue is implemented and maintained on the micro level, in any available software. Stakeholders of the service catalogue are both the IT and business side, and this way; it is the joining link between these two parties. Therefore, several respondents describe the used language as a critical success factor.

On the meta and macro levels, strategic decisions are made. The micro level is dependent on these levels and communication is given from them (Kanchanavipu, 2008). One respondent clearly states that the benefit and development perspective must be rich and give the operational level a conviction of what needs to be done. Also the ownership of development and maintenance needs to be fully described.

6. SUMMARY

The study has shown that three factors need to be considered at the implementation and emergence of SOA; ownership, communication and competence. Ownership needs to be connected on both a strategic and an operational level. The responsibility and authority regarding ownership has to be clarified to all stakeholders. These two parts of ownership, and also the factor that the service ownership lays both on the IT and the business side, will give dynamic to the service development and bring the emergence forward.
The factor of communication is seen from two perspectives in the study, the decision levels and the entire organization. The degree of details increases between the different levels, which means that the strategic communication from the meta level must be overall. On the macro level, the communication contains information regarding the architectural design of SOA and on the micro level, the communication is rather operational. This can be in shape of a service catalogue, which also can be seen as the connection point between consumer and provider. For the entire organization, the study implicates that language must be stringent and clear.

Competence is the third factor discussed in the study. Participants in different groups need to share SOA competence in order to make the emergence dynamic. This competence can come from the business or the IT side, and the participants also need to know what the knowledge requirements are for the level they belong to. The study implies that development of SOA often starts from a bottom-up level, due to the fact that the top management does not have the necessary competence regarding services.

The overall guideline from the study is that SOA is not just a technical implementation; it is a way to develop the business. The metaphor: “…services are this cognac on a tap” (researcher of Direct communication, 2010). Cognac can be seen as the rich information useful for the consumer and the tap is the standardized way the provider shall distribute the information.

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Proposing Learner E-dentity to social presence in digital spaces for learning

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Abstract

Social learning is essential in digital learning spaces. However, it can be difficult to know who your fellow learners are, due to the limited amount and quality of available cues. This lack of social presence could have negative effects on participation, which is the basis for social learning. The aim of this paper is to theoretically explore the implications of an explicit digital student identity. Drawing on literature on participation, presence, interaction, and identity, I propose a student e-dentity with the purpose of enhancing social presence and awareness. The implication of such an e-dentity is a more transparent social environment within digital learning spaces.

1. INTRODUCTION

To understand and value an interaction correctly, it is essential to know with whom one interacts (Ke, Chávez, Causarano and Causarano, 2011). In digital spaces only some cues allowing one to read the other, and construct an image of who she is, are present. In text based discussion forums, for example, cues are limited to such elements as e-mail addresses, signatures and language (Donath, 1999). Also in more advanced digital spaces many cues are lost, which leads to a decreased social presence, i.e. the degree to which users in a digital space perceive each other as real (Gunawardena and Zittle, 1997). This could serve as a block when it comes to user interactions. In digital learning spaces, interaction between users (learners and teachers) is possible to various degrees. Socio-constructivist learning relies on Vygotsky’s (1978) theories, and holds that learning is constructed
socially in the meeting between people. In other words, interaction between users is vital for learning. Interaction can take diverse forms, and meaningful interaction (Woo and Reeves, 2007), i.e., interaction leading to knowledge construction, can be supported on different levels by instructional design and system design. Interaction can be supported by instructional design by for example exercises demanding social collaboration. System design can support interaction by for example offering a space that facilitates and/or invites to interaction. In this paper, I will explore the latter. I have often experienced a lack of social presence within digital spaces for learning, making me feel as if I was all alone within the space, even though I have known others were there at the same time. Similar feelings of lack of social presence have also been described in literature (Kear, 2010). This has made me wonder what is lacking within these digital spaces.

Learning communities rely on participation. Mutual engagement, which is one of the bases for Communities of Practice (Wenger, 2000), evidently requires interaction. Hence, it is vital – ultimately for successful learning – to facilitate interaction in digital spaces. A way to approach this could be to allow for more cues about peers, by the use of expressed identities. Digital identities has been discussed in relation to e-portfolio, with the purpose to facilitate administrative work (Ittelson, 2001), or in order for the learner to promote oneself to possible employers (Bauer, 2009). However, as far as my knowledge, there has been no discussion in literature of digital identities with the purpose of enhancing a feeling of social presence and awareness. Hence, the aim of this paper is to theoretically explore whether an explicit digital student identity could reinforce social presence and awareness, enhance participation, and ultimately strengthen learning. This leads to the following research question:

Q: What would be the implications of an explicit digital learner identity for social presence and awareness in digital learning spaces?

The discussion on identity in this paper concerns the social aspects of “the I”, it is not related to any administration or verification issues. The paper is organized as follows: In the next section, “Method”, I will describe how the study was performed. Following, in “Social Learning – Theoretical Foundations”, I will unfold the paper’s theoretical foundations of socio-constructive learning and related terms. The next section, “Digital Identity – Related Research”, shows previous work regarding identity. In “Discussion” the findings derived from literature is developed into a proposal. In the last section, “Concluding remarks and further research”, I conclude the paper and describe how to take the research further and in what direction.

### 2. METHOD

This paper is based on a literature study. The main database used was SCOPUS. The main keywords used were learning (in the forms of e-learning, digital learning
and *Technology-Enhance Learning*) in addition to *identity, presence, interaction* and *participation*. Initially, my main interest was on journal articles published in 2010 or later. From selected articles, from here on referred to as *important hits* within stated search criteria, I would track articles in the three directions: back, forwards and parallel. Back-tracking would refer to checking seemingly interesting references of the important hit. Forward-tracking would be exploring those citing the important hit, which was often a manageable count since the important hits would be recent publications. Parallel-tracking would be to check “related articles” provided by databases such as Science Direct. During the tracking, any article could be selected as an important hit, and the three directions (or any of them) would be tracked also in this layer. Hence, the search method is multi-layered and uncontrolled to the extent that any thread could go on until my interest was lost and the web of tracked threads could end up uneven. I make no claim of having explored the whole web of threads; there are undoubtedly holes in it. But I do believe to have arrived at a certain saturation, where several threads have articles in common. Additionally, related articles known to me previously and peer-recommendations were incorporated into the study, sometimes as important hits. A limitation of the study model is that there is a risk of getting caught up in details, of focusing on a certain part of the whole. This could lead to other relevant areas being involuntarily excluded. This gives the model a deep, rather than broad approach. I have then used the findings in literature to interpretatively evaluate the implications of a digital student identity. This was done by using the theories on social learning, presented in the following section, as a foundational setting, to advocate the shortcomings and needs of digital learning situations related to social issues. Related research on digital identity, in section 4, was used to evaluate how digital identities are used, and how they could be used in order to enhance digital learning situations.

3. SOCIAL LEARNING – THEORETICAL FOUNDATIONS

The fundamental theoretical approach on which this paper relies is social-constructivist, based on Vygotsky’s theories on learning, which can be summed up as: learning is constructed in the space between people (Vygotsky and Cole, 1978). Knowledge is built socially and only as a second step is it internalized. An important concept in Vygotsky’s theories is the “zone of proximal development”, which refers to the distance between learner’s point of departure and at what level of knowledge the learner’s arrives after the interaction with another or others (ibid.). Hence, the aim of an effective learning situation would be to arrive as close as possible to the far boundary of the zone of proximal development. Consequently, it is vital in a learning space that social interaction and participation is facilitated. However, quality of interaction is of superior value to quantity of interaction in order to reach social learning (Garrison and Cleveland-Innes, 2005).
Of main interest in learning situations is meaningful interaction (Woo and Reeves, 2007), i.e. interaction that leads to knowledge-construction. In a study based on a mixed approach of qualitative and quantitative method, it is concluded that a major part of available study time was spent on social (only) interaction rather than knowledge-constructive interaction (Shane, 2006). The reason was that the social only phase preceded and served as grounds for the knowledge-constructive interaction phase. Hence, to shorten the introductive socialization phase would be valuable for learning.

Learning communities build on participation. The work regarding Communities of Practice (Wenger, 2000) also has a socio-constructive approach. In Communities of Practice it is essential that the members of the learning community are mutually engaged, and that they participate and share knowledge and work together towards a common goal. The theoretical framework of Communities of Inquiry describes three essential parts in order to arrive at successful learning, namely Social Presence, Cognitive Presence and Teaching Presence (Garrison, 2007). The three parts work in synergy. While Communities of Practice and Communities of Inquiry have much in common in regard to learning approach, they have their point of departure in different settings and perspectives. Communities of Practice is descriptive and is based on practise within organizations. Communities of Inquiry has its setting in Higher Education and is prescriptive. However, participation is a basis for both views of learning communities. Hrastinski (2008) defines online learner participation as:

[*] a process of learning by taking part and maintaining relations with others. It is a complex process comprising doing, communicating, thinking, feeling and belonging, which occurs both online and offline. (p. 1761)

Important to note in the definition is that thinking, feeling and belonging are ways of actively participating, equally active as doing or communicating. Negative effects on engagement and participation may be a result of low social presence (Kear, 2010). Social presence is the degree to which users in a digital space perceive each other as real (Gunawardena and Zittle, 1997). Social presence, as in social interaction without learning purpose, is a natural first step, but is not enough to lead to learning without cognitive and teacher presence (Garrison and Cleveland-Innes, 2005). Hence, though not independently a key to success, social presence is a crucial part to attend to, when designing digital learning spaces.

4. DIGITAL IDENTITY – RELATED RESEARCH

Social presence can be reinforced by system design, for example by enabling user profiles, since they can offer a feeling of knowing each other better (Kear, 2010). Drawing on previous research, Kear (2010) describes that beneficial parts of user profiles could be photos, names, interests, résumés and location. In her study based on interviews, Kear (ibid.) finds that a problem concerning social presence
specified by learners is the need to get to know something about each other. This illustrates the frustration triggered by impersonality in digital learning spaces. In the same study, students reported that they appreciated a history function, allowing them to check who had read posts and when. This might seem to interfere with integrity, but it allows for an awareness of peers’ actions, which valuable to feel accompanied through the learning experience. Furthermore, it reveals reading peers, i.e. “silent” but yet active social participation (Hrastinski, 2009). Awareness about peers’ activities is a social aspect which is only partly covered by interaction. Transparency in a learning situation can enhance awareness and means that users can have “...insight in to each other’s activities and resources” (Dalsgaard and Paulsen, 2009, p. 2). Once peers become visible, they become potential partners and resources (ibid.). Hence, transparency is a social attribute with the potential to contribute to a more open and inviting digital learning space.

In connection to Communities of Practice, Wenger (2000) deals with identity as something in between individual and community; the identity is influenced by both. This could be described by both our inner self and our context/culture influences how we experience and present ourselves. In addition, identities are continuously changing, and learning in itself is one thing that influences this change (ibid.). In digital spaces, it is essential to know the identity of those with whom we interact, to be able to judge the validity, and to properly understand the interaction (Donath, 1999). Equally important is the trust in others (ibid.). In a recent study (Ke, Chávez, Causarano and Causarano, 2011), identity presence in online discussion is shown to have a correlation to knowledge-constructing interaction rather than to social interaction only (interaction without purpose of learning about the study object). Hence, knowing more about the other builds up trust, understanding and judgement of validity, which in turn offers fertile ground for learning. There are of course reasons to evaluate to what extent individuals should be made explicit. In a study on design of online communities (Yuqing Ren, Kraut and Kiesler, 2007), it is argued that personal knowledge of each other could increase off-topic interactions. The study builds on social theory and is in contradiction to the studies earlier in the paragraph. Still, since learning communities (mostly) start out with a common goal (of learning), it is possible to argue that knowing more about each other in order to promote interaction could be of profit.

Identity has been discussed in literature regarding e-portfolios. While remembering that the primary purpose of the e-portfolio is a tool for learning (as opposed to pure assessment), a social portfolio has recently been proposed (Garrett, 2011). The design model for the social portfolio includes ease of use, social learning and ownership as predictions of user satisfaction. The approach also increases social learning (ibid.). E-portfolios are also mentioned to enhance self-awareness, but the social portfolio also contributes to the awareness of peers. In a
short communication, Ittelson (2001) requested a student e-dentity. The e-dentity would, according to Ittelson be an administrative tool for educational institutions and an extended e-portfolio. The purpose was mainly assessment, and an identified problem was security and safety issues. Bauer (2009) refers to Ittelson (2001) regarding student e-dentity in his reflections on the use of e-portfolios. His experience of an Open Source e-portfolio software is the basis for his view that the e-portfolio is a good way of building digital student identities. He pictures e-portfolios as only one part of three needed to create the digital student identity. The other two parts are Personal Learning Environment and Social Network. The main objective for a digital student identity is, according to Bauer (2009), self-promotion, for example towards potential employers. Ravent (2007) also connects e-portfolios with digital identity, and ask whether “...ePortfolio being the mere projection of one’s identity?” (p. 228). He points to software developers’ challenges of a single log in to connected systems, user owned and organization owned, and the demand of users to plug their e-portfolios to their existing social networks (ibid.). While depicted as beneficiary for the learner, there are also obvious administrative purposes. Those purposes were made even more obvious in a recent publication by Ravent and colleagues (Ates, Ravet, Ahmat and Fayolle, 2011). In a position paper published in 2009 (Ravet), he points to the importance of interoperability of e-portfolios, as well as it being essential that they are student owned. Evidently, digital identity and e-portfolios are closely related.

5. DISCUSSION

Drawing on the previous section, it is essential for learning to facilitate and invite to knowledge-constructing user-interaction. But when interaction takes place face-to-face there are many cues, which we are experts in reading: a twitch, a nod, a yawn or “that look” etc. This has been practised since the beginning of mankind. When moving this interaction into digital space, we are all beginners in reading each other. Just as education should not be directly transferred from on-campus into digital space, but be allowed to have its own unique expressions, the way we interact should also be allowed to form its own ways in digital space. A way to prepare for this could be to make our digital identities explicit. When we meet face-to-face, there are things that are difficult to explain, there are feelings, “chemistry” that could take place between people. These feelings can make it easier for us to open up to each other, to really meet, and to be ready to discuss a subject or problem with the purpose of learning. Hence, for learner interaction in digital spaces to flourish, there are demands other than face-to-face interaction. A first step towards facilitating interaction and mutual engagement could be to unveil “the I” by the use of explicit identities.

I find it surprising that no-one has of yet taken the term of e-dentity, offered and left hanging by Ittelson (2001), and turned it into something real. Literature on
the use of e-portfolios have referred to Ittelson’s e-dentity when advocating the usefulness of e-portfolios when building a student identity online (Bauer, 2009). The purpose of these has been self promotion, making one’s identity visible to others outside of the learning situation such as for example potential employers. Other purposes of digital identities related to e-portfolios (Ravet, 2009) have been, in accordance with Ittelson (2001), of administrative reasons. A danger with the identity track is when it starts including control, as is claimed by Ravent and colleagues (Ates, Ravet, Ahmat and Fayolle, 2011). Administrative and control issues comes with inherent security risks, and one might also expect problems with user acceptance. A useful contribution from research on an administrative kind of identity, also valid for my approach, is interoperability and user-owned identities (Ravet, 2009).

To compensate for the lack of cues in digital spaces for learning, I propose a universal learner identity that can be migrated into various digital learning spaces: the learner e-dentity. The e-dentity that I propose is not just an e-portfolio, but rather the next step towards self representation. It should be the representation of “the I” in digital learning spaces – the electronic I. This e-dentity contains personal information, such as name, images, areas of interests or whatever the learner wishes to put forward in order to tell others who she is. Additionally, the e-dentity also contains the student’s portfolio, and previous knowledge. There are also meta-data connected to the e-dentity, showing where the learner is within the digital space. This is to create awareness and transparency (Dalsgaard and Paulsen, 2009) to allow students to feel accompanied through the learning experience. Functions such as micro blogging/status line are also part of the student e-dentity, in order to be more alive and increase transparency. The e-dentity must be student owned, and under complete control of the owner. An important reason for this is that identity is ever changing (Wenger, 2000). Hence, the e-dentity must be just as changeable. Since the student is the owner of her e-dentity, she can choose which in systems to use the e-dentity, which functions should be activated and how she wishes to use those functions. The e-dentity can be migrated and is universal/platform independent, so that the student is really able to build up her digital identity. In this way the student will not need to create an account and start over every time she changes system. Much of this is in accordance with Bauer’s (2009) description of an ideal e-portfolio; the additions not described by Bauer are the meta-data regarding student actions and the interaction functions such as the micro-blogging. Furthermore, the e-dentity has another purpose, namely to enhance social presence and awareness. Although the e-portfolio and the e-dentity may have many functions in common, the use is different. Additionally, due to the widespread misconception of e-portfolios main purpose being assessment, I strongly suggest that e-dentity is a better suited label for the digital student identity. Also, the traditional use of portfolios, for example among artists, has been
to showcase one’s abilities. To express one’s identity is something different and should not be confused by terminology shortcomings.

An apparent student identity can only advance the learning situation to a certain extent. Thoughtful instructional design and additional aspects of system design are still crucial in order for the e-dentity to be able to contribute its potential. Teachers are also users in a digital learning space, and teacher e-dentity could also be valuable compared to the above. Not to forget, the e-dentity, first of all, facilitates social presence. However, following the framework of Communities of Inquiry (Garrison, 2007), also cognitive presence could be facilitated by the e-dentity since it makes aspects such as previous knowledge explicit. Knowing about peers’ previous knowledge could invite elaborate, subject specific discussions. Offering explicit identities could actually decrease the social only interaction, the interaction with the sole purpose of getting a better picture of one another, and allow learners to more directly advance to knowledge constructing interaction.

6. CONCLUDING REMARKS AND FUTURE RESEARCH
In this paper I have proposed a possible approach to enhance social presence and awareness in digital learning spaces. The proposition is a learner e-dentity, which makes student identities explicit in digital spaces. The implications of learner e-dentities would be a more transparent social environment within digital learning spaces. Cues available in physical spaces are lost in digital spaces. However, explicit learner identities could compensate this loss by offering more cues, though of a different kind. As a first step, the validity of such an e-dentity has been shown here, based on literature. The design of the e-dentity and practical implementation could be subject to future research. Student acceptance, practical use validity and practical feasibility are parts of that future work.

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CRITICAL INFORMATION AND ITS IMPLICATIONS

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1. INTRODUCTION

The introduction of Internet to a broad public entailed a not completely foreseen change in information availability. There is information available on almost any topic and the sources of information are innumerable. To search information on internet has even generated a new verb, to Google, which refers to using the Google search engine to find information. The new possibilities to communicate on a global arena give people, besides consuming information, the opportunity to produce information as well. As the sources vary a lot, the quality of the information retrieved also varies, with the result that it can be contradictory and some may even be partially or totally incorrect. Another problem with the large amount of information is that you can get information overload. The term information overload was presented as early as 1968 (Gross, 1968) and further popularized by Toffler (1970). The term was used to describe the effects and means to avoid or minimize the undesired effects that have been discussed during the last decades. See for example (Souren and Nazareth, 2010; Bawden and Robinsson, 2008; Soucek and Moser, 2010). Wurman (1989, 2001) introduces the term "information anxiety" to describe the large amount of information and humans' limitations in processing it.

In addition to Internet all kinds of media are used for information spreading like radio, TV, newspapers and not to forget text and photo messages on telephones. Any news can be spread almost simultaneously all over the world.

For individuals acting on a personal level the availability of information is mostly an advantage rather than a problem. Blur or incorrect information may cause inconvenience but seldom any damage. Organizations on the other hand need adequate and correct information to accomplish their tasks. The tasks may of course be more or less critical and thereby also the requirements on information more or less crucial. As much of the research performed by the informatics research group at Mid Sweden University in Östersund concern situations when critical information is needed, the group has begun to use the term Critical Information to describe their research. In this paper, the “whats and hows” of critical information are discussed.
2. CRITICAL INFORMATION

First I want to present the statement that the research group has made concerning critical information.

Critical information is highly dependent on the context, the time and the place. Critical information is governed by the needs of the potential user and should have enough quality for the purpose it should be used for. Critical information is tightly coupled to the consequences the lack of information might have for individuals, groups, organizations and society in need of it. Thus critical information must be made accessible to the different target groups who need it. Different adequate measures have to be used in order to minimize or avoid possible damages. In systems where critical information is contained and maintained, there should be possibilities to aggregate information depending on different needs. Finally, we mean that it is important to work together with different stakeholders in design these systems.

Let us take a closer look at some of the statements above.

Consequences
Critical information is tightly coupled to the consequences the lack of information might have for individuals, groups, organisations and society. As I interpret this statement it is meant serious consequences like life and health, or severe damages on properties. Duff (1996) argues that the word critical tells us all about the importance. Losing or misusing critical information has severe and intolerable consequences.

On individual basis an example can be information about conflict situations or need for special vaccination when going to a foreign country. For an enterprise lack of critical information may cause great economic loss or even the end for the company. An example can be a change in a law concerning additives that make your product unsellable. What we have concentrated on is risk and emergency situations on society level. Lack of information may delay the time rescue work or even aggravate the situation.

Accessibility to information
Critical information must be made accessible to the different target groups who need it. This does not mean that everybody must have the same information. It rather means that everyone must have the information needed to carry through his or her task. You can often here that it is essential to have a common picture of the
situation. Of course some common understanding of the situation is necessary, but in detail the information needed must be adjusted to the individual’s role.

The process oriented emergency management approach addresses the crucial issue of different understandings of the emergency situation. Today emergency training and simulation tools assume that involved organizations and individuals have the same image, or view, of the emergency site/situation, although empirical evidence indicate differently (Alvinius et al., 2007; Danielsson et al., 2007). Different organizations, as well as individuals within organizations, understand the situation differently and need different information depending on their task, position, information, knowledge, organizational culture and preparedness for action. (Asproth et al, 2010)

**Information quality**

*Critical information is governed by the needs of the potential user and should have enough quality for the purpose it should be used for.* An interpretation of this statement suggests that the information need not be of highest quality, but have enough quality for the purpose. Information may be incomplete or blurry but can still be useful for the situation. In an emergency situation the first reports may be very imprecise but still enough to start making efforts to solve the situation.

Soliman and Yossef (2003) have found the following characteristics of information quality: accuracy and precision, timeliness and currency, relevance, conciseness, completeness, good presentation and cost-effectiveness. It can be noticed that in that list are also characteristics like relevance and good presentation. As important as the ordinary quality measures are that the user of the information needs it and that he/she can see and understand it.

Vassiliadis et al (2000) argues that quality can be defined as fitness for use. The nature of this definition directly implies that the concept of information quality is relative.

**Time and place**

*Critical information is highly dependent on the context, the time and the place.* The nature of critical information is that it also mostly is time critical. If the needed information was not present at, or before, the situation when it was needed, undesired effects will appear. In the individual example it is essential to get the information about the foreign country to visit so close to the departure as possible, but in time to take actions. A company affected by new regulations need time to adjust the production before the regulation takes effect. In emergency situations the time is a matter of life and death. As too much information can be very stressing if situations with extremely time-critical information there is also a need to limit the information and present only the most significant information (Horvitz and Barry, 1995). The place that the information concerns is also necessary to expose. The epidemic demanding vaccination may be present only in one part of a
country, while the rest of the country is safe. In emergencies the information about the place of the disaster and the location of rescue resources are crucial for the outcome (Asproth and Ring, 2011)

To complete the picture I want to make a distinction between Critical Information and Critical Information Systems. Critical Information Systems are systems that are critical to an organisation. An example is the system for application to university studies. If such a system is down the last days (weeks) before the last application day, the university may suffer from economic losses. For a company a system for stock-in-trade may be a critical information system. Critical information on the other hand can be retrieved from many different sources. A telephone call from a citizen being at the right spot at a given time may supply critical information to a rescue organisation as well as an alarm from any alarm system. A critical information system may or may not contain critical information.

3. AN EXAMPLE OF CRITICAL INFORMATION

One of the projects the informatics research group is leading is a project called “Gaining Security Symbiosis” (Gränsöverskridande samverkan för säkerhet). The project aims to development of skills, techniques and procedures to be able to deal with joint crisis management and security-threatening situations in the Mid-Northern border areas. Mid Sweden University and The Nord-Trøndelag University College are in charge of the project. The project and different aspects of it is described in for example (Asproth et al, 2010; Asproth and Nyström, 2010; Dubois et al, 2010; Asproth and Ring, 2011; Asproth et al, 2011).

The project is based on the problems, difficulties and challenges within the field of emergency rescue and security that the project collaborators and the project stakeholders are currently experiencing in their activities. Problems with security and safety are in many respects particularly accentuated in border areas. To deal with the difficulties with management of emergencies in border areas there is a need for learning about each other’s organisations and resources. The project is organised in three yearly cycles with scenario creation, training and evaluation. In addition a system, netAgora, is built containing scenarios, outcomes from training and evaluation from the training. In addition a visual support for the training is included in the system.

During the scenario creation phases and in the training situations the critical information needed is identified. The first cycle of training and evaluation has been performed and from the observations made it is obvious that the need for information differ between the different roles. Knowledge about where to find information and, on the other hand, when to inform or who to inform is still undeveloped. A lot of training and getting to know each other still remains.
Disasters create a large number of victims, disable transportation systems, and place excessive demands on first responders, i.e. ordinary citizens who happen to be on the disaster location. Many important and urgent post-disaster needs cannot be addressed quickly or adequately by the official rescue organisations. Hence, bystanders and victims do not simply wait for any rescue team to show up. They take initiative to care for themselves and for others. (Asproth et al, 2010)

Research has consistently shown that citizens engage in emergency response after a disaster (Drabek and McEntire, 2002).

4. RESEARCH DIRECTIONS FOR THE FUTURE

The compiling of the implications of critical information generates some areas that need to be further investigated. Some of the problems that have been arisen have also been subject to research for decades but still they are not completely solved. The list is not in any respect to be seen as complete or containing the research areas of greatest importance. The list, however, contains areas that are of importance for the availability and display of critical information.

Information overload
Prior studies suggest that an increase in the number of information cues provided to decision makers can have an adverse impact on their decision making performance (Souren and Nazareth, 2010).

Ashby (1958) states in his Law of Requisite Variety, that “only variety can destroy variety”. That means that you have to use as much types of information as the problem you are going to solve. Ashby suggests that measurement of the quantity of information, even if it can be done only approximately, will tell where a complex system falls in relation to the individual’s, team’s or organisation’s limitation. If it is well below the limit, the classic methods may be appropriate; but should it be above the limit, then if his work is to be realistic and successful, the strategy must be altered to one more like that of operational research.

In Beer’s Viable Systems model (Beer, 1979) filtering of information between different system levels is of great importance. When creating viable organisations this is crucial.

Many attempts to create filtering functions have been done, for example (Horvitz and Barry, 1995) who developed techniques for real-time control of the configuration and quantity of information displayed to a user, and a methodology for designing flexible human-computer interfaces.

Artificial intelligence and intelligent agents are techniques that have been used to approach the problem.
Information quality
There is a lot of research that tries to find ways to ensure information quality. Among others can be mentioned Lena-Maria Öbergs work on traceability (Öberg, 2011)

It is not always necessary to have information with very high quality. To have some information is better than nothing. When information is missing or incomplete a fuzzy logic technique can be used. Research aiming in that direction has been made.

Another angle to the problem is not to over-emphasize the aims at getting the highest quality in all respects, but to visualise how high the quality and/or the uncertainty of the information is. Some examples of research in this field can be found in (Asproth and Håkansson, 2003; Asproth, 2007a).

Trust
In the earlier described project “Gaining Security Symbiosis, GSS”, co-operation between different organisations and between organisations in different countries are performed. A good deal of trust must be built in for such a co-operation to work well. The essential requirements for creation of trust are described in (Asproth, 2007b; Asproth and Nyström, 2012).

Soft early warning systems (SEWS)
In many situations an early warning about that something is going to happen, quite an advantage. Companies can get warnings about preparations for new laws and regulations or that the market is to be totally changed. For emergency management early warnings may affect the outcome of the situation or even prevent a disaster to happen. Many early warning systems to discover for example earthquakes and tsunamis are installed all around the world. Many emergency situations are however preceded by unknown and uncertain information that is not easy measured. To catch and analyse this kind of information a soft early warning system is needed. Asproth et al (2011) is discussing a security-SEWS for emergency prediction and prevention.

5. CONCLUDING REMARKS

Critical information is information that leads to severe consequences if it is missing. The availability of all kinds of information from all sorts of media can be of great help, but is also likely to overwhelm decision-makers, keeping them from finding the adequate information.

The paper has brought out some research direction to make it easier to find relevant, high quality and trustable critical information. As can be seen many
research ideas in this papers direction has been brought to attention, but much work still remains to be done.

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